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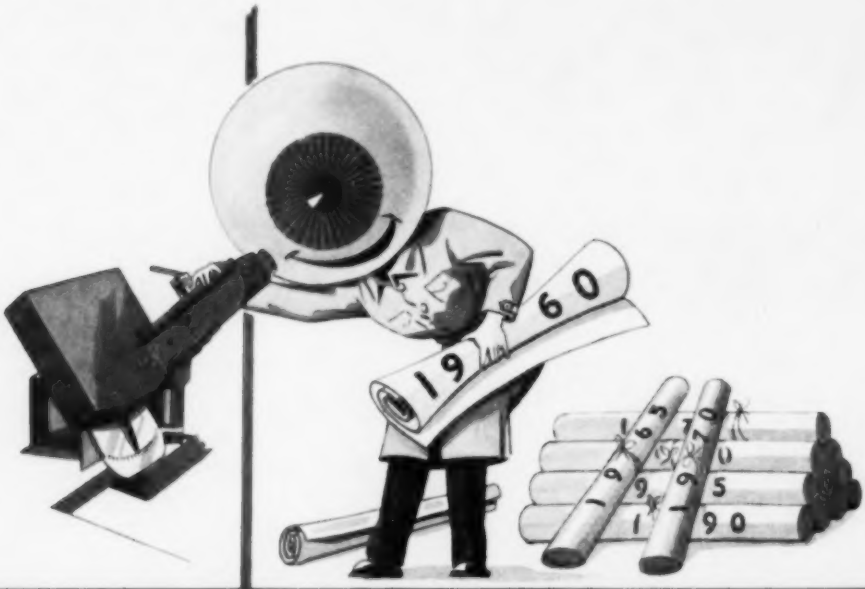

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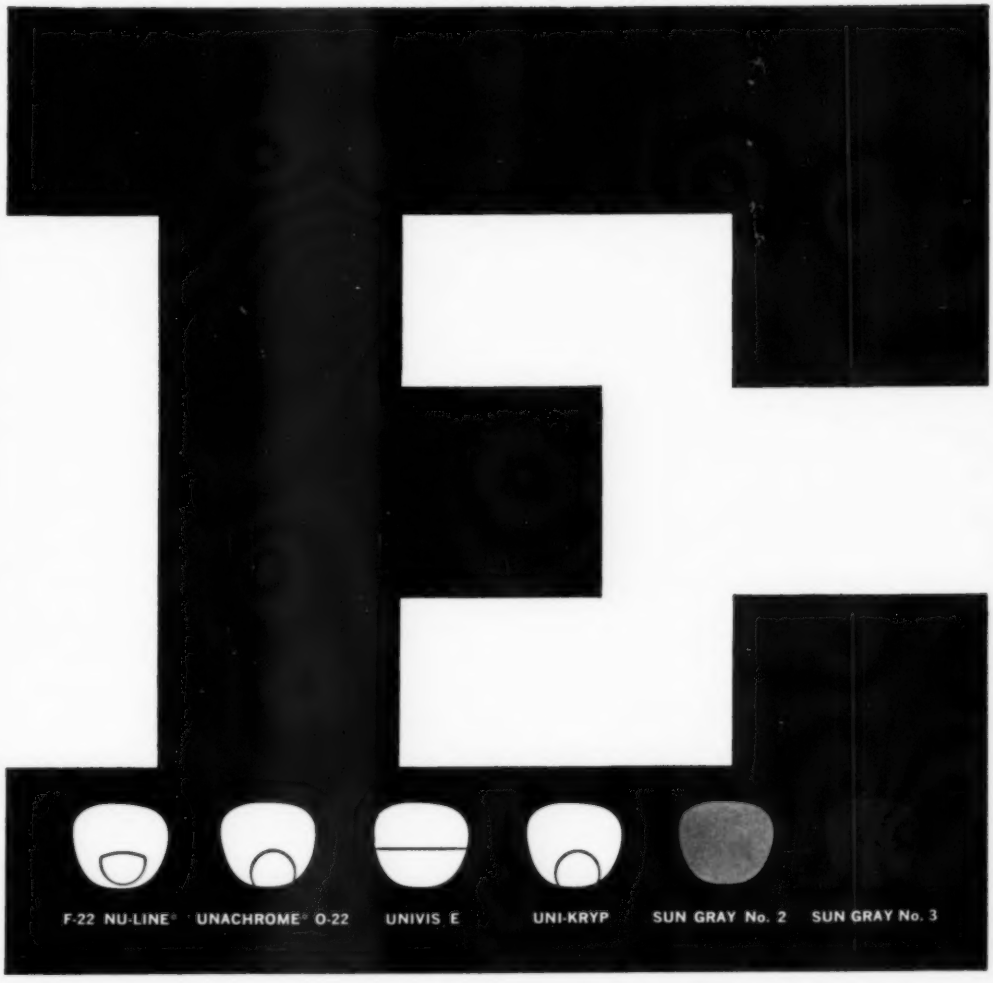

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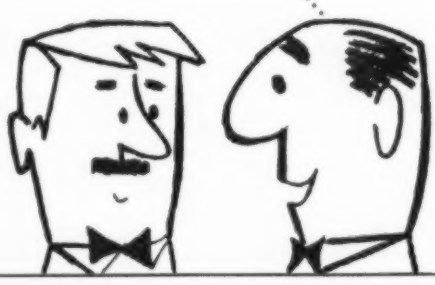

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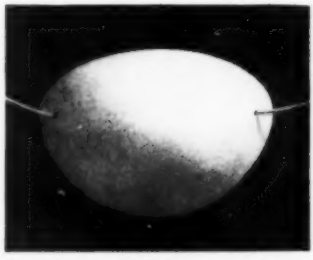

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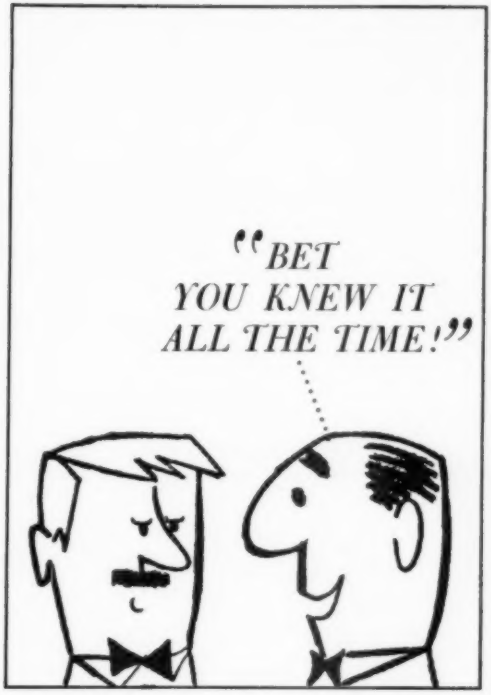

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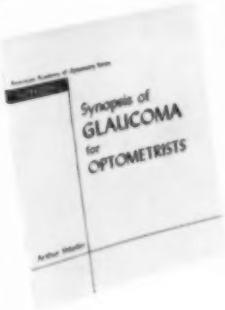

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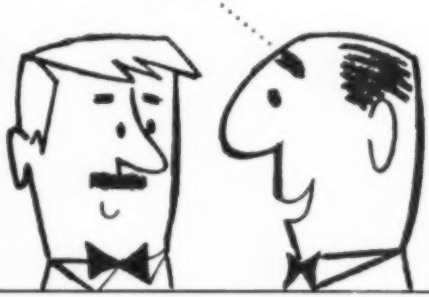

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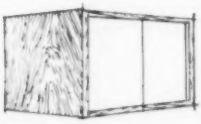

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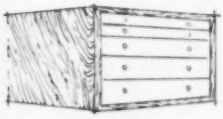

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[See page 49]

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Vol. 37 January, 1960 No. 1

FOVEAL FIXATION DISPARITY MEASUREMENTS AND THEIR USE IN DETERMINING THE RELATIONSHIP BETWEEN ACCOMMODATIVE CONVERGENCE AND ACCOMMODATION*

Frederick W. Hebbard†
School of Optometry, The Ohio State University
Columbus 10, Ohio

INTRODUCTION

In binocular vision the visual axes of the two eyes need not intersect exactly at the point of regard for it to be seen singly. Such a deviation of the visual axes from exact bifixation is known as fixation disparity. If the visual axes intersect in front of the point of regard, a positive (or eso) fixation disparity exists; a negative (or exo) fixation disparity means that the visual axes intersect behind the point of regard.

Ogle,[1] who has studied the phenomenon more extensively than anyone else, credits Lau[2] in 1922 with having been the first to describe and correctly interpret the condition. It appears, however, that Judd[3] recognized it 14 years earlier, as a result of a photographic study of the eyes while fusing points by means of free stereoscopy. He found that during divergence "the center of fixation for the right eye must be regarded for practical purposes of fusion as lying somewhat further to the left" than the position taken during exact monocular fixation. "There is obviously also some tendency for the left eye to fixate permanently the region which lies somewhat to the right" of the exact monocular fixation position. "It would, therefore, seem to be true that in voluntary divergence the optical axes are not brought into a position of direct fixation upon the point, but the eyes are so adjusted that the points to be fused fall approximately at the centers of vision, though in reality somewhat at one side." Using today's terminology, one would say that Judd's records showed positive fixation disparity, as is now known to occur during forced divergence.

*Based on a paper read before the Annual Meeting of the American Academy of Optometry, Chicago, Illinois, December 12, 1955. Submitted on August 1, 1959, for publication in the January, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Ph.D. Member of Faculty. Fellow, American Academy of Optometry. The work described in this paper was done at the University of California School of Optometry while the author was the recipient of an American Optometric Foundation grant.

The possibility of fixation disparity was suggested as early as 1858 by the work of Panum,[4] who showed that the images of an object need not fall on exactly corresponding parts of the two retinas for a percept of singleness to occur, and for whom Panum's areas are named. A Panum's area is the region in one retina on which a point of light can be imaged and be seen singly in binocular vision when a similar image lies on a fixed point in the other retina. Thus, single binocular vision may occur when the retinal images do not lie on anatomically corresponding points in each retina, i.e., points which have homologous oculocentric directions,[5] or which have the same monocular primary subjective direction.[1] Indeed, the fact that this is so, helps to make possible the impression of solid depth in binocular stereopsis. In effect, Panum's areas permit a tolerance in the convergence of the eyes so that fixation disparity can occur without at the same time causing diplopia. However, if some defect or hindrance to the fusional mechanism causes a deviation of the visual axes larger than the diameter of Panum's areas, the result will be diplopia, rivalry, or suppression.

When single vision occurs while the retinal images lie on noncorresponding points, the perceived direction of the binocular image may be that of the dominant eye, or there may be a compromise so that the perceived direction lies somewhere between the separate monocular directions. During binocular vision when an extra mark is visible to one eye only, it is believed that the perceived direction of the mark will be the same as if the eye not seeing it were closed. All the subjective measurements of fixation disparity depend upon this reasonable assumption.

Measurements which so far have been reported in the literature have been subjective. That is, the subject whose fixation disparity is measured observes a fusion target and aligns two monocularly seen measuring marks. Typical of such methods is that of Ogle.[1] The central area of a fusion target is blocked out and replaced with a vernier measuring field containing two vertical arrows which are seen by polarized light. Polaroid filters are placed before the eyes so that each arrow is seen by a different eye. One of the arrows is adjustable sidewise by means of a micrometer, and the amount of displacement needed for the subject to align the arrows subjectively is a measure of the fixation disparity.

Since the subject is instructed to fixate the arrows, fusion is maintained by means of peripheral contours only. With such an experimental design there is no foveal bifixation or fusion and, strictly speaking, fixation disparity is therefore not being measured. Some writers try to avoid this criticism by calling such a phenomenon extrafoveal or

peripheral fixation disparity, although such terms are in themselves somewhat contradictory. Possibly a fixation disparity might better be called a vergence error or vergence discrepancy, since it is only during binocular vision that a fixation disparity can occur. Fixation disparity does, of course, consist of uniocular components. An error in fixation occurring in monocular vision is classified as eccentric fixation. In this paper, fixation disparity with foveal fusion is called foveal fixation disparity, as contrasted with nonfoveal fixation disparity, measured with fusion prevented in the central field.

Fixation-disparity measurements are of particular clinical significance because they provide a means for studying the relationship between accommodation and convergence during haplopia, whereas fusion is prevented when this relationship is investigated by most other methods. In 1949 Oglet et al.[6] found that a 1 D. lens change had the same effect on fixation disparity as a prism of 3.5Δ-4Δ. This agrees exactly with the AC:A (accommodative convergence:convergence) ratio of 3.5 to 4 which is found on an average when fusion is prevented.

Most of the investigations of fixation disparity have been made with fusion prevented in the central field. Under such conditions, fixation disparity rarely exceeds 20 min. of arc, with a total range of about 40 min. during maximal forced convergence and divergence. Experiments of Ogle[1] have indicated that as the size of the central fusion-free area is decreased, the range of fixation disparity decreases, in relation to the decreasing size of Panum's areas towards the fovea. Some measurements of foveal fixation disparity have been made by Ogle, and by Carter.[8] The method of Mitchell and Ellerbrock[9] also provided very close to foveal fusion in the horizontal meridian if their target was bifixated at either of their measuring marks.

The present investigation was begun in order to obtain subjective measurements of foveal fixation disparity to compare with objective measurements, made by photographically recording the positions of the eyes. The latter work will be reported separately. However, because of the limited information available about foveal fixation disparity, its investigation was extended and also included a study of the relationship between foveal fixation disparity, accommodation, and convergence, as well as a comparison between foveal and nonfoveal fixation disparity.

APPARATUS AND PROCEDURE

A laboratory hapliscope was modified by adding a lateral carrier, PN (Figure 1), with a micrometer adjustment to the right convergence arm, M'K. The subject's head was held in position by forehead and chin rests. The fusion target, T (shown in Figure 2), was placed at

Fig. 1. Schematic arrangement of haploscope, viewed from above. Convergence arms AM″J and BM′K each rotated about a point directly below the center of rotation of the left and right eyes, respectively. Mounted on each convergence arm was a cell, C, to receive test lenses or prisms; a semi-silvered mirror, M, which imaged the stigma in the direction of the fixation target, T; an optometer lens, L; and a stigma, S, which could be moved along the arm, which was calibrated to give readings to be transformed into diopters. The right stigma, S′, was mounted on a micrometer carrier, NP, which could be moved along the right arm and used to adjust the stigma sidewise across the arm.

eye level in the subject's median plane 50 cm. from the trial-lens cells, C, or about 51.4 cm. from the vertex of the subject's cornea. The fusion target was 5¾ in. wide by 7 in. high. This was large enough so that its extremities were outside the subject's field of view through the apertures of the haploscope. Each of the three horizontal or vertical lines

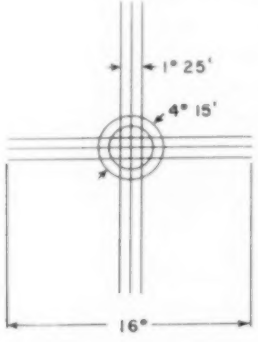

Fig. 2. The fixation target. When located 51.4 cm. from the eyes, as for these experiments, its dimensions in visual angle were as shown.

was ¼ in. apart. The haploscope optometers, S′ and S″, lenses L′ and L″, semi-silvered mirrors M′ and M″, and lens cells C were mounted on two convergence arms, each rotating around a point directly beneath the center of rotation of the subject's eye on that side.

The targets, S′ and S″, in the haploscope optometers consisted of tiny pinholes punched in thin discs of copper and illuminated from behind. Such optometers are called stigmatoscopes, and the points of light are called stigmas. By means of the semi-silvered mirrors, M′ and M″, the stigmas were imaged in the direction of the fusion target, T. The subjects were made optically emmetropic by placing the necessary correction lenses in the lens cells, C. During binocular vision while the subject bifixated the fusion target, the optometers were each adjusted along their arms so that the stigmas were as clear as possible. The distance of each optometer along its convergence arm was read from the scale and by means of a calibration table the reading was transformed into diopters. This permitted the accommodative response for target T to be determined for each eye. During monocular vision the left haploscope arm was rotated slightly so that the stigma seen by the left eye was exactly centered on the middle vertical line of the fusion target, just below the middle horizontal line. The right stigma was adjusted by means of the micrometer so that it appeared to be exactly centered on the center vertical line, slightly above the middle horizontal line. A microswitch controlled by the subject's foot flashed the two stigmas alternately. During binocular vision, as the foot control was operated at a rate of about one alternation per second, the stigma appeared to jump up and down as a result of phi-movement. The stigmas could also be presented continuously and simultaneously if desired.

The stimulus to convergence was varied by means of prisms placed in the haploscope lens cells, C. In order to obtain nonfoveal fixation-disparity measurements, the fusion target, T, was modified by cementing a circular disc with a narrow black outline over the central part of the cross. Various sizes of discs were made, but only the 1.5-degree-diameter disc was used in this experiment. The stigmas were then imaged in the center of the disc. A black thread was stretched vertically in the middle of the target in order to align the stigmas monocularly when obtaining the "zero" findings. However, the thread was removed while fixation disparity was measured, so that no fusion contours would lie within the disc.

The following procedure was used in obtaining each set of foveal measurements. Each set resulted in one point on the graph of data

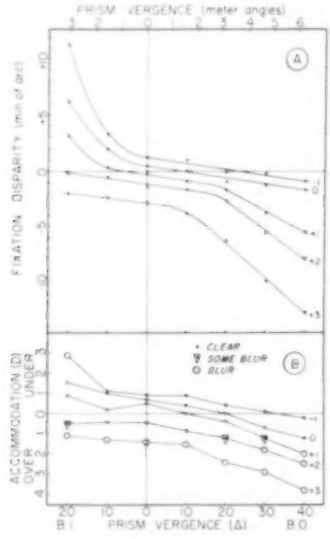

Fig. 3. A. Fixation disparity as a function of prism vergence, measured during bifoveal fusion of the fixation target, located 51.4 cm. from the eyes, with lens adds in diopters as shown for each curve. B. Accommodation as a function of prism vergence, measured during bifoveal fusion of the fixation target. The lens add in diopters for each curve, and the degree of blur of the fusion target are shown. Under- or over-accommodation refers to the difference between accommodative response and stimulus. If the stimulus is 2 D and the response is 3 D, a 1 D over-accommodation exists.

(Figure 3). The prism power was equally divided between the two eyes. The haploscope convergence arms were initially adjusted so that the fusion target appeared centered in the haploscope apertures for each eye. In such a position the stigmas were about centered on the middle vertical line of the fusion target. During binocular vision each haploscope optometer was adjusted until the stigma was seen with the sharpest outline, and the position of each optometer along its arm was recorded for eventual transformation into dioptric values for the subject's accommodative state. During binocular vision the observer kept the fusion target as clear as he could. The appearance of the fusion target was recorded in three degrees of clearness: sharp, some blur, or very blurred.

The right eye was then closed and, leaving the accommodation setting of the optometers in position henceforth, a fine adjustment of the left convergence arm was made so that the stigma seen by the left eye was precisely centered on the middle vertical line of the fusion target, and the left convergence arm was then securely locked in position.

Trying to keep his head motionless, the subject then closed his left eye and opened his right eye. Then, by adjusting the micrometer, which moved the right stigma laterally across the fusion target, the subject moved the stigma until it was exactly centered on the middle vertical line of the fusion target. Because the micrometer had considerable backlash, the settings were always made by moving the image of the stigma from left to right across the target.

The micrometer settings were then recorded, and ten such settings were usually made, although fewer were sometimes made when the scatter was small and more when it was large. When prisms of greater power were used there was prism dispersion, and this led to larger scatter of the settings. Another factor was the difference in accommodative response during monocular vision, when the preceding micrometer readings were taken, as compared to binocular vision. To some extent this could be compensated by voluntary stimulation or inhibition of accommodation, but this would, of course, cause a blurring of the fusion target comparable to that experienced under binocular viewing conditions for such prism strength. Centering the stigmas on the fusion target for various viewing conditions indicated that the averages of sets of readings were similar, whether the stigmas were sharp or somewhat blurred.

The average of the monocularly determined readings was considered to be the "zero" finding. If in binocular vision the two points of light could be centered exactly above one another to give the same mean micrometer setting, there would be no fixation disparity.

The fusion target was next viewed binocularly. The stigmas were flashed alternately while the upper one was moved from left to right until it appeared to jump up and down vertically. The micrometer reading was then recorded. The subject constantly attempted to keep the target as clear as he could. The scatter of such readings was usually greater than that of the monocular determinations to obtain the preceding "zero" finding. However, for low amounts of prism power the scatter was small. It gradually increased as prism power was increased, being greatest when the limits of fusion were approached. As scatter increased, the number of settings was increased. For many of the sets, 15 readings were considered adequate, but over 100 were made during observations to determine whether prolonged viewing might result in compensation to fusional stress.

A second set of "zero" readings was obtained after each set of fixation-disparity measurements. Every time the prisms were changed to different strengths, a new set of zero readings was made.

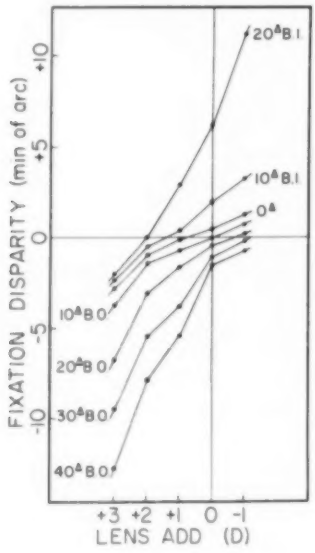

Fig. 4. Fixation disparity as a function of lens add, measured during bifoveal fusion of the target. These data are the same as plotted in Figure 3A. The prism power used to obtain each curve is also shown.

The same procedure was used in taking the nonfoveal measurements, using the 1.5-degree disc to remove fusible contours from the foveal area, except that the zero settings were made by aligning the stigmas with the black thread, which was removed while fixation disparity was being measured. The subject fixated the stigmas, which were imaged near the middle of the disc.

The foveal fixation disparity data were taken during a 25-day period, and the 1.5-degree data were obtained during a subsequent 15-day period. Although Ogle[1] has reported that the results are affected by the order of taking such data with varying amounts of prism vergence, this was not found to be significant for the present experiment. This may be a result of the time spent realigning the subject and taking the "zero" readings between each set of data.

RESULTS AND DISCUSSION

Four subjects were used in this study, although one was used much more extensively. Only the results of this one subject are reported, since the results of the others were in agreement.

A family of curves showing the relationship between foveal fixation disparity for the one subject for a range of prism vergence from 20Δ

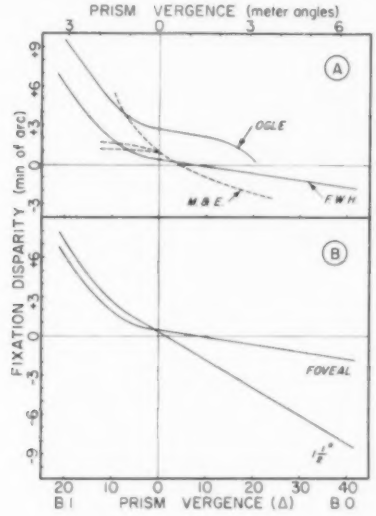

Fig. 5. A. The foveal fixation disparity curve as a function of prism vergence with zero lens add obtained in this study, as compared to curves obtained by Ogle, and Mitchell and Ellerbrock. See text. B. Fixation disparity as a function of prism vergence, obtained with zero lens add and bifoveal fusion, as compared with the fixation disparity obtained for the same subject and lens add when no detail existed in the central 1.5-degree-diameter area of the fusion target.

base-in to 40Δ base-out for five different lens stimuli to accommodation is shown in Figures 3A and 4, where fixation disparity is plotted, respectively, as a function of prism vergence and lens add. In Figure 3B the accommodative response curves are shown for the various lens stimuli throughout the range of prism vergence. The degree of blur of the target is also indicated.

The fixation disparity for the foveal plano lens curve (Figure 3A) varied from 6 min. eso at 20Δ prism divergence to 2 min. exo at 40Δ prism convergence, a total range of 8 mm. This range can be compared (see Figure 5A) to that of Ogle[1] for the sum of the uniocular components of fixation disparity, since his experimental arrangement probably permitted bifoveal fusion. Ogle's range was about 10 min., for a smaller range of prism vergence, 6 meter angles as compared with more than 9 for the present study. When compared with the curve of Mitchell and Ellerbrock[9] (Figure 5A), who used a smaller target with a method which provided very close to bifoveal fusion in the horizontal meridian if their target was bifixated at either of their measuring spots, the range is almost identical for a similar range of forced vergence (12Δ

base-in to 20Δ base-out), being slightly over 3 min.

Considering the differences in methods and subjects, the agreement in range of fixation disparity among these studies seems good.

RELATIONSHIP TO PANUM'S AREAS

The range of foveal fixation disparity ought to be no larger than the diameter of foveal Panum's areas, which is about 12 min., according to the data summarized by Ogle.[1] The plano lens curve for the present study is well within this range, as are the results of Ogle, and Mitchell and Ellerbrock. However, when all lens stimuli are considered, the total range of foveal fixation disparity is 23 min. Consequently, foveal Panum's areas may be larger than previously thought. However, it must be remembered that some of these data in the present study were obtained while the target was blurred. It is not unexpected that a larger disparity might be possible while contours are blurred, since the two ocular images could be more out of registry before diplopia would be noticed. If only those portions of the curves obtained while the target was clear are considered, the total range of fixation disparity is less than 9 min. It follows, then, that the effective size of foveal Panum's areas is increased when the retinal image is blurred. This idea is in agreement with the fact that Panum's areas also increase in diameter as the angle away from the fovea increases, and as acuity decreases. The diameter of a Panum's area may be considered the threshold for "binocular resolution," and it is not inconsistent that binocular resolution falls (Panum's areas increase in diameter) as monocular resolution falls. Obviously, monocular resolution is not the only factor in determining the effective diameter of Panum's areas, since monocular foveal resolution may be better than 1 min. whereas foveal Panum's area may be at least 10 times as large in diameter. It is here that neural and motor factors, such as physiological nystagmus, may be introduced, as Gertz,[10] and Vukovitch and Schubert[11] have done.

COMPARISON BETWEEN FOVEAL AND NONFOVEAL FUSION

A family of curves is shown in Figure 6 for the same subject as in Figure 3, under the same experimental conditions except that no fusible detail was in the center 1.5 degrees of the field of fixation. Points plotted two or more times for one accommodative and convergence stimulus condition were averages of 10 or more readings, usually taken on different days. A comparison of the foveal and 1.5-degree curves for no lens add is shown in Figure 5B. The increased slope of the plano 1.5-degree curve as compared with the foveal curve, and the range (16 min.) of the plano 1.5-degree curve are consistent with findings of Ogle. This is about twice as large as Ogle's own estimate for the dia-

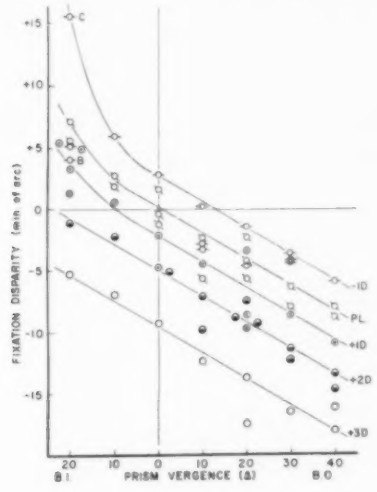

Fig. 6. Fixation disparity as a function of prism vergence, when no detail existed in the central 1.5-degree-diameter area of the fusion target, located 51.4 cm. from the eyes, with lens add in diopters shown for each curve. Similar designs of datum points indicate repeated sets of measurements with the same lens add. The points for 20Δ base-in and —1 D add marked B and C were obtained, respectively, with the fusion target blurred and clear.

meter of Panum's areas in that zone. The total range for the 1.5-degree curves, when all lens stimuli are considered, was about 34 min. of arc. Some of the data included in this range were taken with the target blurred.

RELATIONSHIP BETWEEN ACCOMMODATION AND CONVERGENCE

When one eye is occluded while the other eye sees a target for which the stimulus to accommodation may be varied, both eyes will accommodate in response to the stimulus. In addition the occluded eye will converge in almost exact proportion to the increase in accommodative response of the eyes. This kind of convergence is known as accommodative convergence. The ratio between accommodative convergence and accommodative response is known at the accommodative convergence:accommodation ratio, or simply as the AC:A ratio.

The convergence status at any accommodative level when fusion is prevented may be determined by measuring the angle by which the visual axes fail to intersect the fixation point. If this angle, commonly called the phoria, is plotted as a function of accommodation (see line AP, Figure 8), a straight line will result and its slope will equal the AC:A ratio. The phoria may be readily measured in clinical practice as well as in the laboratory.

Although accommodative response may be measured accurately in the laboratory by means of various types of optometers, it is not easily measured in clinical practice. Consequently, in clinical practice accommodative stimulus change is used instead of accommodative response change when specifying the accommodation in the AC:A ratio. This substitution is based on the assumption that change in accommodative response is directly proportional to change in accommodative stimulus as long as the test target is seen clearly. However, owing to such factors as depth of focus of the eye, the change in response may not be equal to change in stimulus, and clinical measurements of the AC:A ratio may sometimes be misleading. Thus it is essential when considering the significance of AC:A investigations that one determine which "measure" of accommodation, accommodative stimulus or accommodative response, is used in the AC:A ratio. We may speak of the AC:A ratio obtained under clinical conditions as a clinical or stimulus AC:A ratio, as contrasted with the true AC:A ratio, or response AC:A ratio.

Binocular fusion must be prevented with most methods used to investigate the AC:A relationship. However, in 1949 Ogle et al.[6] showed that this relationship can be measured during binocular vision by means of the fixation-disparity technique. They found the same change in fixation disparity when using a +1 D. lens add as when they used 3.5 to 4 prism diopters of base-out prism. This prism:lens ratio of 3.5 to 4 agrees well, as already mentioned, with the mean AC:A ratio found by Morgan[14] with a large number of clinic patients.

Martens and Ogle,[7] in their study of the prism:lens ratio of 250 patients, found that for most patients it was linear over the range investigated, but that for 8-10 per cent of the subjects the ratios were nonlinear. Interestingly, linear prism:lens ratios were found with absolute presbyopes and with other patients even when so much plus lens power was added as to blur the target to the extent that details could barely be discriminated. Martens and Ogle concluded that their technique measured the AC:A ratio in presbyopia. However, since accommodative response cannot possibly follow the stimulus in absolute presbyopia or when the target is blurred by plus lens, it follows that the prism-lens ratio measured by the fixation-disparity technique is not necessarily a measure of the AC:A ratio.

The current findings indicate that the relationship between accommodation, convergence, and fixation disparity is not simple. Although the subject of Figures 3, 4 and 6 has a linear AC:A ratio of about 9Δ per diopter change in accommodation when measured in the laboratory with the haploscope, the fixation-disparity findings give prism-lens ratios

varying from 3.3 to 43, depending on how the ratios are determined.

METHODS TO DETERMINE PRISM:LENS RATIOS

Method 1 involves measuring the prism:lens ratios directly from a graph such as Figure 3A, where fixation disparity for various lens adds is plotted as a function of prism vergence. Since each curve represents a 1 diopter change in lens power, the P:L ratio at any part of the graph is merely the intercept along the abscissa between any two curves. For example, measuring leftward from zero prism along the abscissa from the plano lens curve to the +1 D. lens curve gives a horizontal intercept of 13Δ, which is the P:L ratio. In some instances the horizontal intercepts between any two curves are equal to 9Δ (as, for example, between the plano and the +1 D. curves, from 4Δ to 13Δ base-in), but they are usually larger.

Method 2 is a modification of method 1, in which the prism:lens ratio for a 2 or 3 diopter change in add is determined. For example, the P:L ratio for the plano curve at zero prism vergence may be obtained by measuring the horizontal intercept (in prism diopters) between the +1 D. and —1 D. curves and passing through the zero add curve at zero prism vergence, and dividing by two. In this case it is from 11Δ base-in to 15Δ base-out, or 26Δ/2, or 13.

Method 3 involves dividing the slopes of the curves of fixation disparity for various adds plotted as a function of prism vergence (Figure 3A) into the slopes of the curves of fixation disparity for various levels of prism vergence plotted as a function of lens add (Figure 4). For example, the slope of the zero vergence curve at zero add (Figure 4) is 0.714 min./D. The slope of the zero add curve at zero prism vergence (Figure 3A) is 0.057 min./Δ. The P:L ratio is 12.5.

Method 4 is a variation of method 3, except that the assumption is made that the curve between any two points should be linear. The P:L ratio for zero prism vergence and zero add could be found by finding the slope of the zero add curve between the experimental points at 10Δ base-in and 10Δ base-out (in this case 0.10 min. per prism diopter) and dividing into the slope of the zero prism-vergence curve between adds of +1 D. and —1 D. (in this case 0.714 min. per diopter), giving a P:L ratio of 7.1. This result differs from that of method 3 mainly because the slope of the zero add curve at zero vergence (Figure 3A) is less than the slope of the line joining the experimental points at 10Δ base-out and 10Δ base-in.

Method 5 is the one used by Ogle and his co-workers.[6, 7] Basically, it involves comparing two curves of fixation disparity, the one plotted as a function of prism vergence, as in Figure 3A, and the other plotted

as a function of lens add, as in Figure 4, in order to find the various prism vergences and lens adds where the disparity is equal. The derived P:L ratio curves obtained for the present data using this method are shown in Figure 7. An example illustrates how the points for these

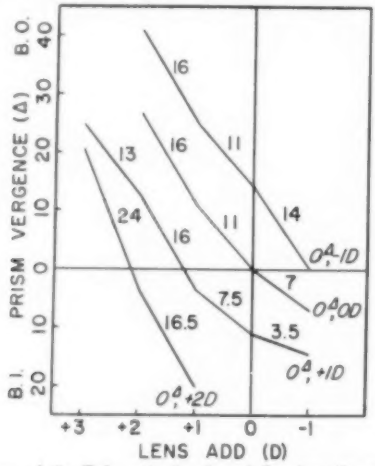

Fig. 7. Derived curves of the P:L ratio for foveal fixation disparity, obtained following the method of Ogle. (See text.) The P:L ratios for each segment of each curve are shown.

curves were obtained. The zero prism vergence curve (Figure 4) shows about +1.3 min. of fixation disparity at —1 D. add. Referring to the zero add curve (Figure 3A), one finds +1.3 min. of fixation disparity at 7Δ base-in. Therefore, a point on the derived curve lies at (—1 D., 7Δ base-in). The P:L ratio for this segment of the curve is thus 7. The segment between zero add and +1 D. add gives a P:L ratio of 11. The mean P:L ratio for this 2 D. segment is 9.

The P:L ratios obtained by these five methods are summarized in Table 1.

TABLE I

Method	P:L Ratio Near Zero Add. No Prism	P:L Ratio Range
1	11.8	4-30
2	13	5-20
3	12.5	3.3-42
4	7.1	5.3-43
5	9	3.5-24

COMMENT

Regardless of the method used to determine the P:L ratios, at least two conclusions follow: (1) Near the region of zero prism and zero

add, the P:L ratio varies between 7.1 and 12.5. This is higher than the average P:L ratio found for other subjects by Ogle and his co-workers, but is consistent with the higher-than-average AC:A ratio of 9 of this subject. (2) The P:L ratio varies significantly over the range of prism and lens adds even though the subject's AC:A ratio is linear over its entire range.

The question arises as to the reason for the nonlinear P:L ratio as compared with the linear AC:A ratio. On theoretic grounds the P:L ratio should equal the AC:A ratio (1) if change in accommodative response equals the change in stimulus, thereby changing accommodative convergence and also fusional vergence by an amount proportional to the AC:A ratio; (2) if fusional vergence changes directly with change in prism; and (3) if the same fusional vergence, whether a result of prisms or lenses, produces an identical fixation disparity.

The P:L ratio would also equal the AC:A ratio, no matter how much the fusional vergence changed when lenses or prisms were added, as long as a 1 D. change in lens produced the same change in fixation disparity as a change in prism equal to the AC:A ratio. However, on theoretic grounds it is difficult to explain the equality between the P:L and AC:A ratios for this seeming happenstance.

It is with binocular fusion prevented, that AC:A ratios are measured. Yet, P:L ratios measured with the fixation-disparity method are obtained with binocular fusion. For a given lens and prism stimulus condition, the amount of fusional vergence, measured when fusion exists, is apt to be different from the phoria magnitude. Consequently, it is necessary to consider the relationship between accommodation and convergence with fusion present. Fry,[12, 13] Morgan,[14] and others have shown experimentally that the relationship between accommodation and convergence during binocular vision can be represented graphically as in Figure 8. The so-called phoria line, AP, is obtained with binocular fusion disrupted and has a slope equal to the AC:A ratio. Point B represents the fixation point, drawn here for a target 40 cm. from the eyes and requiring about 16Δ of convergence for a subject whose interpupillary distance is 64 mm. As base-out prism is added, accommodation increases very little until point C is passed. When accommodation changes markedly, the curve is parallel to the phoria line and its slope equals the AC:A ratio. When base-in prism is used, accommodation decreases only slightly until point F is passed, and then ultimately decreases in accord with the AC:A ratio.

At the phoria position the fusional vergence used to maintain single binocular vision is zero. At the fixation point, B, it equals b. At point

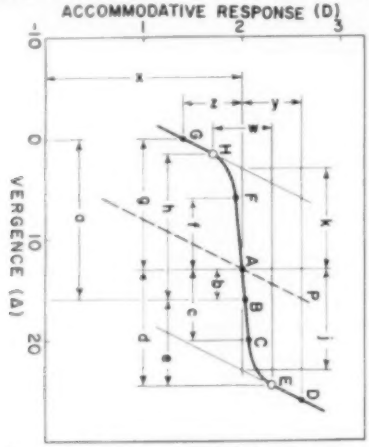

Fig. 8. The relationship between accommodative response and prism vergence. See text.

C it equals c. However, at point D the accommodation has increased by an amount y, therefore supplying accommodative convergence equal to y (AC:A). The fusional vergence will never be larger than j, no matter how much base-out prism is added before fusion is disrupted. A similar analysis for the base-in side of the curve indicates that the fusional vergence will never exceed k. The accommodation decreases at G by an amount z, and if we assign a minus sign to this decrease, the fusional vergence at G equals g — z (AC:A), or k, where k is negative, indicating divergence. Beyond points E and H the subject detects blur, which increases as the accommodative response differs more from the stimulus. The distance w measures the depth of focus. Points E and H clinically are referred to as the limits of positive and negative relative convergence, respectively, measured by e and h, the prismatic powers from the fixation point.

An explanation for such findings may be based on the concepts of Maddox,[15] who divided convergence into four components: (1) tonic, (2) psychic-nearness, (3) fusional, and (4) accommodative. For a given fixation distance, components (1) and (2) are considered constant. Single binocular vision is thereby maintained by variations in (3) and (4). When the limit of positive fusional convergence is reached, accommodation takes place in order to supply additional accommodative convergence, required to supply the total convergence necessary as base-out prism is increased. When sufficient accommodation takes place, the fixation target will, of course, become blurred. When base-in prism is increased to the point that the negative fusional convergence is exhausted, accommodation relaxes, thereby relaxing accommodative

convergence and making the maintenance of single vision possible, even though it is blurred.

A similar type of analysis will also show that when plus or minus lenses are added during binocular vision, the response may differ from that obtained during monocular vision, and if so, fusional vergence will differ, when fusion exists, from the amount of phoria, obtained during dissociation.

If one measures the accommodative response for each lens and prism stimulus condition, it is possible to calculate the fusional vergence using the method above. If response had changed exactly with accommodative stimulus, then the curves in Figure 3B for each lens add would be superimposed. However, the curves in Figure 3B are not superimposed, and therefore response did not exactly follow stimulus. Furthermore, for each lens add, accommodative response varied over the range of prism vergence. When base-in prism was used, accommodation decreased (see Figure 3B), as represented by the increase in under-accommodation for the target. As base-out prism was used, accommodation increased. For the 60Δ vergence range shown in Figure 3, accommodation changed almost 3 D. for each lens add. With the target at 50 cm., as it was here, the subject's phoria was 9Δ esophoria with zero add. The fusional vergence was therefore 9Δ divergence. With 20Δ base-in, the fusional vergence would be 29Δ divergence if accommodation did not change. However, accommodation decreased 1.1 D., thereby decreasing accommodative convergence 9.9Δ (1.1 times the AC:A ratio of 9), making the net fusional vergence with 20Δ base-in equal to 29Δ — 9.9Δ, or 19.1Δ divergence.

With 40Δ base-out, the fusional vergence would be 31Δ if accommodation were constant. However, accommodation increased 1.6 D., thereby reducing the fusional vergence by about 14.4Δ, to 16.6Δ. Consequently, the fusional vergence varied between 19.1Δ divergence and 16.6 convergence, a total range of 35.7Δ, even though the prism vergence varied over a 60Δ range. The results of such calculations made for the foveal data are shown in Figure 9, were fixation disparity is plotted as a function of fusional vergence. If fixation disparity were a function of fusional vergence alone, then (1) all points of fixation disparity would fall along the same curve, no matter what prism and lens stimulus was used during the measurement, and (2) it would be demonstrated that the fixation-disparity method may be used as an accurate measure of the AC:A relationship.

Inspection of Figure 9 shows that in certain instances fixation disparity is closely related to fusional vergence. For example, near zero

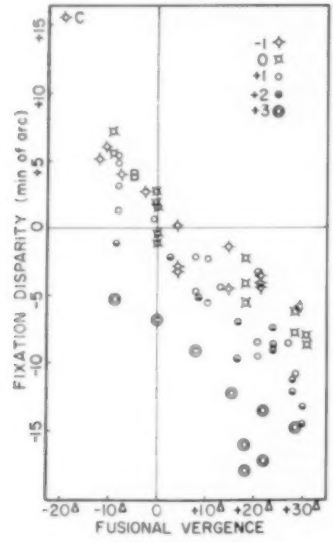

Fig. 9. Foveal fixation disparity plotted as a function of fusional vergence. The lens add in diopters is indicated by the design of the points. These data were calculated from those in Figure 3. See text.

fusional vergence the fixation disparity obtained with —1 D., plano, and ±1 D. adds is almost identical in magnitude. If one uses visual inspection to draw curves through the data, the plano and +1 D. curves are close to each other in their mid-ranges. The —1 D. and +2 D. curves also are closer to the plano curve than when the data are plotted as a function of prism vergence, but there is insufficient intermingling of points with the plano and +1 D. curves to conclude that fixation disparity is a function of fusional vergence alone. The +3 D. curve is clearly displaced downward from the others, indicating that factors other than fusional vergence contribute to fixation disparity under such conditions.

Fixation disparity obtained when no fusion stimulus exists in the center 1.5-degrees of the field is plotted as a function of fusional vergence in Figure 10. Here there is considerable intermingling of points for the —1 D., plano, +1 D., and +2 D., adds although in general the points obtained with more plus add show a downward displacement. For the +3 D. add the points are consistently displaced downward by a larger amount. The same conclusion may be drawn as with the foveal data, namely, that although for limited adds and prism

vergence the fixation disparity is probably more closely related to fusional vergence than any other function, there are also other factors influencing fixation disparity. These other factors, such as blur, have a decided influence for the data taken through the +3 D. add.

EFFECT OF BLUR ON FIXATION DISPARITY

Ogle, Mussey, and Prangen[6] reported that fixation disparity changed very little as compared to that obtained with clear vision when the images were blurred with plus lenses or partial occluder lenses. However, if only one eye was blurred, the fixation disparity did increase. The more recent findings of Martens and Ogle[7] did show that binocular blur can increase fixation disparity. The present findings also indicate that fixation disparity will increase when blur exists for both eyes. In Figures 9 and 10, where fixation disparity is plotted as a function of

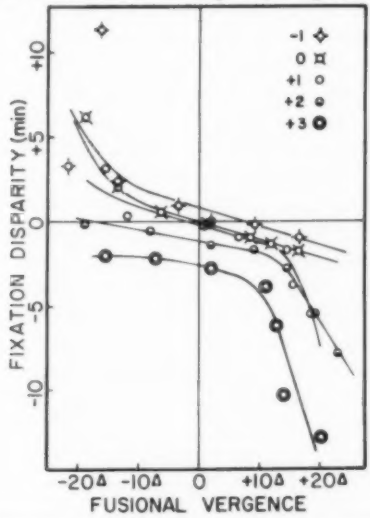

Fig. 10. Fixation disparity obtained with no detail in the central 1.5-degree-diameter area of the fusion target, plotted as a function of fusional vergence. The design of the points shows the lens add in diopters. These data were calculated from those in Figure 6. See text.

fusional vergence, the fixation disparity increased considerably when the +3 D. lenses were used. Since the target was 50 cm. away, these lenses had the effect of blurring the target 1D. As shown by the accommodative-response findings, the accommodation actually increased somewhat with the +3 D. lenses as compared with its minimum level, and the blur was usually more than 1 D. Although factors other than

blur may also have helped increase fixation disparity under such conditions. it is not unreasonable to conclude that blur itself was a major cause of the increased fixation disparity.

In Figure 3B, the discrepancy between accommodation stimulus and response is plotted as a function of prism vergence for each lens add used. The degree of blur is also shown. As one would expect, the blur is generally directly related to the discrepancy between stimulus and response. It is interesting to note the similarity in shape of the fixation-disparity curves in Figure 3A and accommodative discrepancy curves in Figure 3B. This may be considered as further evidence for the hypothesis that the degree of blur has an effect on the magnitude of fixation disparity. It is, of course, only one of several factors, for it can also be shown that for a given prism-vergence state, fixation disparity can be greater when vision is clear than when it is blurred. An example is shown in Figure 6. At 20Δ base-in using a —1 D. add, points B and C were obtained with blurred and clear vision, respectively. Here fixation disparity was largely determined by fusional stress, since with clear vision the accommodative response was 1.3 D. greater than when vision was blurred. The relaxation of accommodation also decreased accommodative convergence by 11.7Δ, so that the fusional vergence with blur was 7.6Δ of divergence as compared with 19.3Δ of divergence when vision was clear. These two points are also plotted in Figure 10.

VARIATION IN FIXATION DISPARITY WITH FUSION TIME

At the outset, measurements were made at several levels of forced convergence and divergence to determine whether fixation disparity would change as viewing time increased. Ogle and Prangen[16] reported in 1953 that fixation-disparity measurements showed a stablizing compensation to base-up or -down prisms, taking 3-10 min. or longer. They credited Schubert[17] in 1943 with having been the first to report compensation to prisms, either base vertical or horizontal. Some of Ogle's findings also led them to believe that such compensation also occurs in the horizontal meridian. Later, Carter[8] confirmed this viewpoint when he found a gradual reduction in fixation disparity during forced vergence with either base-in or base-out prisms when observations extended over a half hour or longer. Mitchell and Ellerbrock[9] reported such compensation for forced divergence only.

Over 100 consecutive measurements made during a 40-min. period of continuous fusion with 20Δ base-out showed no compensation. However, since the initial amount of fixation disparity was less than 1 min., it might be argued that no compensation would be expected. Some 160 measurements over a half-hour period with continuous

fusion with 10Δ base-in, where the initial fixation disparity was less than 2 min., showed no compensation either. However, when base-in prisms were increased to 16Δ, increasing the initial fixation disparity to 6.2 min., the disparity gradually decreased to 3.2 min. after a period of 15 min. and then remained near that level for the rest of the half hour. During the entire observation period the target was clear, but if the subject was told to make a special effort to keep it clear and sharp, the fixation disparity would again increase somewhat. It appears, therefore, that the apparent compensation to fusional stress created with base-in prisms may be produced by at least two factors: (1) the slow stabilizing compensation reported by Ogle and Prangen, which also acts in the vertical meridian and is possibly associated with changes in muscular tonicity; and (2) a gradual though limited reduction in accommodative response, thereby decreasing accommodative convergence and reducing the need for negative fusional convergence to overcome the accommodative convergence in order to maintain fusion. Ogle and Prangen showed individual differences in the first factor in the vertical meridian, and these no doubt also apply in the horizontal meridian, so that the relative contribution of factors (1) and (2) probably differs among individuals.

SUMMARY OF FACTORS AFFECTING FIXATION DISPARITY

The following outline of the factors which influence fixation disparity represents only one of the possible organizations. It is difficult to separate the factors into various groups as, for example, sensory and motor, since fusion is a process which involves both the sensory and motor sides of a feedback loop. Changes in primarily sensory factors can, in turn, therefore modify the motor output.

I. Factors which permit a fixation disparity.
   A. Panum's areas.
   B. Blur of retinal images.

II. Factors which change the magnitude of fixation disparity.
   A. Motor.
      1. Fusional vergence, whether created by a phoria, prisms, or lenses, modified by accommodative or other types of convergence. Increased vergence increases fixation disparity.
      2. Fusional strength or efficiency. Increased efficiency decreases fixation disparity.
      3. Compensation. Compensation decreases fixation disparity.
   B. Sensory.
      1. Dissimilar ocular images: increase in fixation disparity.
      2. Blur: increases fixation disparity.
      3. Visual size of fusion field. An increase in size decreases fixation disparity.
      4. Loss of foveal fusion: increases fixation disparity.

In group I are listed the factors which, in effect, permit a tolerance to fusion, so that the visual axes do not need exactly to bifixate a point for single binocular vision to result.

In group II are the factors which may change the magnitude of fixation disparity. Blur, which is listed as a sensory factor, increases fixation disparity by way of at least two modes of action: (1) increasing the tolerance permitted to fusion (factor IA), and (2) decreasing fusional strength or efficiency (factor IIA2). If blur also produces an increase in accommodative response, as sometimes happens when plus lenses are used, then fusional vergence (factor IIA1) may also be changed.

CLINICAL SIGNIFICANCE

Martens and Ogle[7] have observed that, although there did not appear to be any clear relationship between general clinical examination findings and the existence of nonlinear P:L ratios, there were more patients with complicated clinical problems in the nonlinear classification. In particular, "patients who showed poor response to minus lenses always had a fairly large exophoria (Maddox rod) and symptoms of accommodative asthenopia associated with visual tasks in the reading range." Esophoria was associated with a lower P:L ratio when plus lenses were added.

The subject of the present study has esophoria at near although he is orthophoric at far and has no symptoms or discomfort when reading. He shows a lower P:L ratio as minus lenses are added, which differs from the prediction by Martens and Ogle of exophoria on the basis of such a P:L relationship. However, since they did their work with a part of the central field occluded, their findings are comparable with those of Figure 6, where there was no fusible detail in the central 1.5-degrees of the field. These findings show a nearly linear P:L ratio, although there is a tendency for it to decrease with minus lenses. It appears that there is a need for additional work to show whether nonlinear P:L ratios are of clinical significance.

Even though it may ultimately be demonstrated that there is a close relationship between fixation disparity and clinical findings, fixation disparity measurements are not likely to become a part of a routine eye examination because of the considerable amount of time and care which are needed to obtain good data. However, the possibility exists that it may be useful clinically to study fixation disparity in cases of binocular difficulty not solved by usual clinical methods.

SUMMARY

1. A method was described whereby fixation disparity may be measured with or without fusion present in the central part of the fusion field. The measurements are reported for one subject, made both with foveal fusion and with fusion prevented in the central 1.5 degrees of the

fusion field, for prism vergence of 20 base-in to 40 base-out, and with adds of —1 D. through +3 D.

2. Fixation-disparity measurements indicated the diameter of Panum's areas near the fovea was about 9 min. However, when the target was blurred the effective diameter of Panum's areas at the fovea was increased to 23 min.

3. When fusion was prevented in the central 1.5 degrees of the field of view, the diameter of Panum's areas increased to 16 min., and fixation disparity changed more rapidly during prism vergence as compared with foveal fusion.

4. The relationship between accommodation, convergence, and fixation disparity was discussed. Five methods of calculating a prism: lens ratio based on fixation-disparity data were given. All methods showed a nonlinear P:L ratio for the subject studied, even though his AC:A ratio is linear. Fixation disparity was shown not to be a function of fusional vergence alone. Therefore, the P:L ratio is also determined by factors other than the AC:A ratio. One of these other factors is blur.

5. A decrease in fixation disparity with time when base-in prisms are used was shown. It appears that part of this compensation may result from gradual relaxation of accommodation.

6. The factors which influence fixation disparity were summarized and the clinical significance of fixation-disparity findings was discussed.

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ANNOUNCEMENT

MARKS HEADS SHURON

Roy Marks, executive vice-president of the Shuron Optical Co., was named president by Textron, Inc., of which Shuron is a division. He assumed his new duties January 2. He succeeds Donald F. Southgate who has been Shuron president since 1954 and is retiring after 43 years of service. Southgate announced the change in administration on December 18. Southgate rose through the ranks of advertising to head the firm.

Shuron is a major manufacturer of frames, lenses, cases and machinery used by ophthalmic laboratories. The company has two plants in Rochester and two in Geneva. A fifth is under construction at Barnwell, South Carolina. The company was acquired by Textron in 1958.

Roy Marks, 47, whose career has been entirely in the optical field, has held successively important sales and administrative posts for three optical manufacturers.

He attended the University of Cincinnati and Illinois College of Optometry, returning to the latter for his doctorate in optometry in 1942.

Marks was a salesman, later a territorial manager for Univis Lens Co., Dayton, Ohio, from 1932 until 1941, when he was made works manager. Four years later he was elected vice-president in charge of sales.

He left Univis in 1950 to become manager of ophthalmic distribution for Bausch and Lomb Optical Company. In 1953 he joined Shuron as vice-president for sales, and was named executive vice-president in May, 1956.

He received the honorary degree of doctor of ocular science from Illinois College of Optometry in 1948. He is a fellow of the American Academy of Optometry.

A STUDY OF THE EFFECTS OF CERTAIN DRUGS ON ALTERATIONS OF FOVEAL DARK ADAPTABILITY*

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Dark adaptation appears to consist of two separate processes. The first one is cone function (cone or foveal dark adaptation), quick in reaction and short in duration, while the second one is a rod function (rod or peripheral dark adaptation), slow and prolonged.[2, 3] In recent years great advances have been made in aviation. People now fly more frequently at night. It is generally accepted that the speed of one's dark adaptation is an important factor concerning safety in night flying. Therefore, a study of improvement in foveal dark adaptation may be interesting. In a previous study,[1] evidence has been presented that the ability of foveal dark adaptation can be improved by the oral administration of nicotinic acid amide or strychnine nitrate. The present communication will be dealing with the effects of vitamin A, riboflavin, methionine, choline and creatine in that respect.

METHODS

Tests for dark adaptation of the fovea were made in a dark room by means of a Nagel's adaptometer. The test field for the apparatus is circular: it was 1.0 cm. in diameter (occupying 1 degree visual angle). A small red light, 1.5 mm. in diameter, was used as a fixation point and placed just within the upper margin of the test field. The subjects' eyes were exposed under light for 5 minutes for preadaptation (200 millilamberts). Near the end of that time the subject was given notice and at a given time the light was turned off. The subject changed his seat at once and took his eyes from the adaptometer just 57 cm. from the test field. During the subsequent time in darkness, the subject was instructed to adjust the wheel reading of the adaptometer with his right hand to such a degree at which the dim light of the test field became just imperceptible (the light intensity of the presentation was determined before measurement). This adjustment was repeatedly done at

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given time intervals and the readings thus obtained were given as the logarithm of the brightness in microlamberts.

RESULTS

Two subjects (F. and H. weighed 69 and 50 Kg. respectively) were selected for test. They were both normal, healthy and well trained on the use of the adaptometer. At the early beginning of the test, the foveal dark adaptation went so fast that it could not be measured accurately. This difficulty lies not so much on the determination of the intensity, but on the measurement of the exact time when the dark adaptation just begins to take place. Therefore, all readings taken in the first 10 seconds of dark adaptation were purposely discarded. In the next half to one or two minutes of dark adaptation the threshold still dropped rapidly, so the measurement had to be done as quickly as possible. Each subject was repeatedly tested until a constant level including the normally unavoidable variability was obtained. The average and the range of the 10 control experiments are given in Table 1.

TABLE 1. AVERAGE OF 10 CONTROL MEASUREMENTS OF CONE DARK ADAPTATION FOR SUBJECTS F. AND H.

Time in Dark (Min.)	LOG INTENSITY (U_1 U_1 1.)			
	Subject F.		Subject H.	
	Average	Range	Average	Range
½	6.11	6.05 - 6.21	6.21	6.16 - 6.26
1	5.73	5.72 - 5.75	5.46	5.45 - 5.47
2	5.70	5.67 - 5.72	5.46	5.44 - 5.49
3	5.66	5.65 - 5.67	5.45	5.44 - 5.48
5	5.66	5.65 - 5.67	5.45	5.43 - 5.47
7	5.67	5.66 - 5.69	5.45	5.42 - 5.48
9	5.67	5.64 - 5.68	5.42	5.38 - 5.46
11	5.67	5.66 - 5.68	5.41	5.36 - 5.46

Let us now take the effects of these drugs on the foveal dark adaptation into consideration. It can be noted that after a single dose of vitamin A per os, such as 100,000 or 200,000 I.U., no effect was seen at all (Fig. 1A and C). When 40 or 100 mg. of riboflavin was given, the result was still the same as that of vitamin A (Fig. 1B and D)

It was found that 5 gm. of methionine taken by mouth resulted in an increase of foveal dark adaptability with corresponding lowering of threshold. This means that after an oral administration of methionine the subject could perceive much dimmer brightness than he did before the drug was taken. Such an improvement in adaptability appeared about one hour after the methionine intake and lasted for approximately 5-9 hours (Table 2 and Fig. 1A and C). Three gm. of methionine produced a similar but slightly weaker effect with a

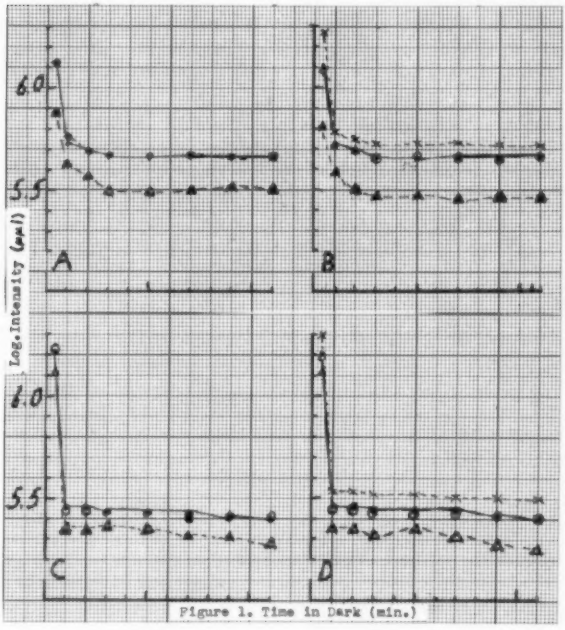

Fig. 1. The effects of Vitamin A, Riboflavin, Methionine, Choline and Creatine on Cone Dark Adaptation

Fig. 1 A (Subject F.)
Dots: Control
Circles: 3 hrs. after 200,000 I.U. of Vitamin A intake
Triangles: 5 hrs. after 5.0 gm. of Methionine intake

Fig. 1 B (Subject F.)
Dots: Control
Circles: 2 hrs. after 100.0 mg. of riboflavin intake
Triangles: 2 hrs. after 3.0 gm. of Choline intake
Crosses: 5 hrs. after 5.0 gm. of Creatine intake

Fig. 1 C (Subject H.)
Dots: Control
Circles: 3 hrs. after 200,000 I.U. of Vitamin A intake
Triangles: 7 hrs. after 5.0 gm. of Methionine intake

Fig. 1 D (Subject H.)
Dots: Control
Circles: 3 hrs. after 100.0 mg. of riboflavin intake
Triangles: 4 hrs. after 3.0 gm. of Choline intake
Crosses: 7 hrs. after 5.0 gm. of Creatine intake

shorter duration of 2-3 hours (Table 3). We also observed a trivial and transient improvement on 2 gm. of choline intake and a definite improvement when 3 gm. of it was administered. The results are given in Tables 2 and 3 and also Figure 1B and D.

TABLE 2. THE EFFECTS OF METHIONINE, CHOLINE AND CREATINE ON THE DARK ADAPTATION FOR SUBJECTS F. AND H.

TIME IN DARK (HR.)	INITIAL	LOG INTENSITY (μμl)															
		METHIONINE (3.0 gm.)					CHOLINE (3.0 gm.)					CREATINE (5.0gm.)					
		TIME AFTER DRUGS TAKE (HR.)															
		1.0	2.0	3.0	4.0	5.0	1.0	2.0	3.0	4.0	5.0	1.0	2.0	3.0	4.0	5.0	
1	6.13	5.26	5.82	5.83	5.82	5.82	5.73	5.72	5.82	5.91	5.92	6.21	6.23	6.23	6.23	6.07	
2	5.73	5.68	5.66	5.66	5.67	5.73	5.65	5.56	5.66	5.64	5.74	5.76	5.76	5.78	5.76	5.72	
3	5.73	5.52	5.62	5.63	5.67	5.63	5.62	5.57	5.61	5.61	5.69	5.71	5.73	5.76	5.70	5.73	
4	5.66	5.36	5.57	5.60	5.60	5.66	5.49	5.36	5.53	5.57	5.64	5.67	5.70	5.72	5.69	5.67	
5	5.66	5.36	5.57	5.59	5.59	5.64	5.44	5.36	5.53	5.64	5.63	5.65	5.70	5.72	5.69	5.66	
6	5.67	5.34	5.56	5.59	5.57	5.64	5.42	5.31	5.53	5.64	5.64	5.65	5.71	5.73	5.70	5.66	
7	5.67	5.36	5.57	5.57	5.57	5.66	5.43	5.32	5.52	5.64	5.66	5.64	5.69	5.73	5.70	5.65	
10	5.67	5.37	5.56	5.57	5.56	5.66	5.43	5.49	5.53	5.64	5.64	5.66	5.70	5.72	5.70	5.66	
		TIME AFTER DRUGS TAKE (HR.)															
		1.0	2.0	3.0	5.0	8.0	1.0	2.0	4.0	6.0	9.0	1.0	3.0	5.0	7.0	24.0	
1	6.71	6.42	6.23	6.12	5.96	6.16	6.16	6.13	6.23	6.14	6.21	6.23	6.29	6.29	6.29	6.25	
2	5.46	5.46	5.41	5.36	5.33	5.44	5.44	5.38	5.36	5.32	5.44	5.48	5.50	5.50	5.51	5.47	
3	5.46	5.42	5.36	5.36	5.34	5.44	5.44	5.38	5.36	5.33	5.43	5.44	5.49	5.52	5.51	5.45	
4	5.45	5.42	5.36	5.37	5.33	5.44	5.42	5.38	5.32	5.31	5.42	5.43	5.48	5.54	5.49	5.45	
5	5.45	5.39	5.33	5.36	5.32	5.44	5.33	5.38	5.36	5.33	5.43	5.43	5.51	5.49	5.49	5.45	
6	5.45	5.39	5.28	5.35	5.32	5.44	5.33	5.36	5.28	5.33	5.43	5.42	5.49	5.49	5.49	5.46	
7	5.45	5.39	5.28	5.35	5.32	5.44	5.33	5.36	5.28	5.33	5.43	5.42	5.49	5.49	5.47	5.43	
10	5.45	5.39	5.28	5.35	5.32	5.39	5.33	5.39	5.27	5.28	5.43	5.41	5.45	5.49	5.47	5.41	

TABLE 3. THE DURATION OF THE EFFECTS OF METHIONINE, CHOLINE AND CREATINE ON CONE DARK ADAPTATION

Subject	Dose (gm.)	Duration (Hr.) Methionine	Choline	Creatine
F.	2.0		1	
	3.0	3	6	
	5.0	9		7
H.	2.0		3	
	3.0	2	6	
	5.0	7		7

The effect of creatine was just the opposite to that of methionine and choline, as 5 mg. of creatine per os. brought about some slight depression with a rise of threshold in the cone dark adaptation as shown in Table 2 and Figure 1B and D inclusively.

DISCUSSION

The histological structure of the human retina (8,3) is such that a central portion of it which subtends a visual angle of 2 degrees is practically free from rods and composed almost entirely of cones, whereas outside of this restricted area the retina contains both rods and cones. In our measurement, the test field occupied a visual angle of only one degree in diameter, so the dark adaptation was essentially a foveal cone function.

Hecht and Mandelbaum[4] and Wald, et al.,[9,10] have shown that a difficiency of vitamin A can impair the ability of the foveal dark adaptation and suggested that this material may take a part in the formation of cone substance. Heiman[5] reported that riboflavin is essential for the

visual function and may play a role in cone vision. In our present experiments we can see that the foveal dark adaptation was not to be improved above the normal level, even if a large dose of Vitamin A or riboflavin was taken. We also found that methionine, choline and creatine had either an improved or a depressed effect upon the foveal dark adaptation. But we cannot explain the mechanism of such a puzzling result, as the nature of the photochemical process of cone adaptation is still not clearly known to us. Practically, however, it is worth a trial to apply methionine or choline in appropriate doses for improvement of the cone dark adaptation. As reported by Hosoya, et al.,[6, 7] either one of these drugs has an improved effect on the rod or peripheral dark adaptation as well.

SUMMARY

As the result of a series of experiments, we have come to the following conclusions:

1. Dark adaptation of the cone portion would not be improved by vitamin A (100,000-200,000 I.U.) or riboflavin (40-100 mg.).

2. Three to 5 gm. of methionine and 2-3 gm. of choline brought about an improvement in foveal dark adaptation, the duration of which varied directly with the dosage used.

3. Five gm. of creatine intake resulted in an opposite, namely slight depressed effect with a rise in threshold.

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TEMPORARY ASTHENOPIA FOLLOWING A CYLINDER AXIS CHANGE — A CASE REPORT*

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This report concerns itself with a young male patient who complained of slightly blurred vision in his right eye which could be detected only at the instant of occluding the left eye. His vision was checked using the Turville Infinity Binocular Balance Test[1] and it was found that the visual acuity was lower in the right eye than in the left eye. Using the Jackson Cross Cylinder, to check the cylinder axis, it was found that a five degree shift in the right eye cylinder equalized the visual acuities. A new right lens was ordered. The before and after prescriptions and the acuities as measured by the Turville technique are given below.

+.25 — 3.50 x 15 20/25
+.25 — 3.50 x 160 20/20+
+.25 — 3.50 x 20 20/20+
+.25 — 3.50 x 160 20/20+

Upon checking the visual acuity through the new lens it was found to be equal to the acuity in the left eye. The patient reported that the vision was clear, but that there seemed to be a pulling sensation in the right eye. The patient was assured that the lens would be comfortable after wearing it for a week or ten days.

Ten days later the patient returned to report that the lens "felt better" but that it was still not completely comfortable. He also had made a very ineresting discovery. Being an amateur astronomer he had been looking at some celestial objects through his telescope without his glasses. As he looked away from his telescope, he noticed that the two astigmatic images of a bright star shifted vertically as he maintained fixation on the star, but swung his head from side to side. When his eyes were straight in his head the two images were superimposed upon each other, but as he turned his head so that he was looking to the left, the left eye image rose in proportion to the amount of his

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head turning. The opposite occurred when he turned his head so that his eyes were looking to the right.

No vertical displacement was noted when he repeated the experiment with his spectacles on. He suggested that the varying imbalance noted with spectacles off might be a conditioned compensation for a prismatic error introduced by the oblique cylinders in his prescription.

Upon calculating the vertical imbalance induced by his lenses at various distances from their optical centers, and then measuring his vertical phoria for various directions of fixation in the horizontal plane, it was found that the phorias *did* vary in such a manner as to compensate for the prismatic imbalance introduced by the prescription! Here then was a possible answer to his complaints of discomfort. The rotation of the cylinder axis had changed the vertical imbalance situation and his compensatory mechanism was taking some time to get adapted to the new relationship. The patient was pleased to know that his observations had contributed a possible solution to his problem. He called in a week later to report that his new lenses were completely comfortable.

Just how much would a five degree rotation change the vertical imbalance in such a prescription? In Figure 1 the dotted lines repre-

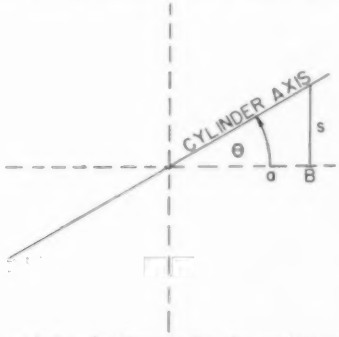

Fig. 1. Diagram used to derive the formula for the vertical prismatic effect at a point B, a cm. distant from the axis of a cylinder lens. The dotted lines represent the horizontal and vertical meridians of the lens.

sent the horizontal and vertical meridians of a lens. The cylinder of power F has its axis inclined at an angle θ. The vertical prismatic effect at B is given in prism diopters by

$$sF \sin^2 (90—\theta)$$

This is Prentice Rule for an oblique meridian in a cylinder, where $90—\theta$ is the angle between the meridian in question (vertical) and the cylinder axis. s will vary as a varies and the prismatic relationship will vary thus—

$$P = aF \tan \theta \sin^2 (90—\theta)$$

$$= aF \frac{\sin \theta}{\cos \theta} \cos^2\theta$$

$$P = aF \sin \theta \cos \theta \qquad (1)$$

Equation (1) is the prismatic effect for one lens. If the astigmatism is symmetrical, the effect is doubled. In the patient reported above then

$$F = 3.50, \ \theta = 20$$

let $a = 1$ cm.

then $P = (1)\ (3.50)\ (.342)\ (.940)$

$$P = 1.125$$

$$2P = 2.25 \text{ prism diopters,}$$

as can be seen this is a considerable effect, especially when one remembers that when he shifts his eyes 1 cm, to the other side of the optical center of his lens that he will now have a vertical imbalance of equal amount, but opposite sign. A total change of four and one half prism diopters over an eye excursion of about forty degrees. Even at half this angular eye movement—which is more realistic—the change will be two and one quarter prism diopters.

Now by changing one lens (going backwards)

$$F = 3.50$$

$$a = 1 \text{ cm.}$$

$$\theta = 15$$

$$P = (1)\ (3.50)\ (.259)\ (.960)$$

$$P = .88 \text{ prism diopters}$$

The change at this point in the lenses is one fourth prism diopter. This is a small amount but it represents a sizeable fraction of the usual vertical amplitude and might very well cause discomfort. Furthermore, the magnitude of the change would vary constantly as the eyes shifted behind the lenses—reaching one half prism diopter during occasional glances close to the edge of the lenses.

It may be of interest to discuss some further general points concerning these effects.

It will be noted that if one differentiates equation Equation (1) one obtains

$$\frac{dP}{d\theta} = aF\ (\cos^2 \theta — \sin^2\theta) = aF \cos^2\theta \qquad (2)$$

from this it can be seen that the maximum change in prismatic effect for a given cylinder axis change is obtained at axis zero and axis ninety and that the smallest change takes place at axis forty-five and axis one hundred and thirty-five. Hence, one need not be as cautious about changing cylinder axes in the case of oblique cylinders as one needs to be when the axes are near the horizontal or the vertical meridians.

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ANNOUNCEMENT

CONTACT LENS CONSULTATION SERVICE FOR OPTOMETRISTS AT THE MASSACHUSETTS COLLEGE OF OPTOMETRY

The Massachusetts College of Optometry, Boston, has established a Contact Lens Consultation Service to be available to the optometric profession beginning February 3. This Service will make it possible for a practicing optometrist to bring his contact lens problem case to the College Clinic, where his case will be studied by members of the Clinic Staff along with the referring optometrist. The Service is not for the purpose of fitting contact lenses for an optometrist, but rather to assist the optometrist who is having difficulty with a case. Equipment is available for making adjustments in the fit of the contact lenses according to the patient's needs.

The Service will be under the direction of Dr. Frederick E. Farnum assisted by Dr. Richard Corbett, Dr. Donald Horley, Dr. Lincoln Palmer, and Dr. Arthur Tieri. All cases will be seen by appointmen. However, before the Staff sees a case, a report must be filed with the Clinic by the referring optometrist covering the events leading up to the present problem which he describes. Thus, the Staff has the opportunity, to some extent, to study the case before it is seen. The fee for the consultation is $5 which is paid by the referring optometrist to guarantee the appointment and help defray the expense in conducting the Clinic. The members of the above Staff will contribute their staff time in the interest of the profession.

VISION AND ACHIEVEMENT IN KINDERGARTEN*

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In recent years a number of investigations have been carried out to determine the relationship between batteries of visual skills tests and achievement in school children. Such studies have employed, for the most part, visual screening tests and have used as criteria of adequate visual skills cut off points recommended by the manufacturer of the screening device or derived from empirical data. Such surveys have in general shown a positive relationship, although instances in which no relationship was present have been cited. In general such surveys have been found most adequate at the later primary grades and the high school age levels.

METHOD

The present study was designed to investigate the relationship between measures of visual skill and school achievement at the kindergarten age level. Fifty children enrolled in the kindergarten of the West Lafayette Public Schools** were used as subjects. The testing was administered in May at the end of an academic year.

A total of twenty visual skills tests were used. These tests included four measures of motor control of the eyes (binocular rotation, monocular rotation, saccadic fixation, near to far fixation). A measure of the near point of convergence obtained by the "push up" method and an estimate of Donder's amplitude. The remaining measures were taken from the Keystone battery.

For each of the tests in the series, a five point rating scale was constructed. This scale was designed to divide the range of performance

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§M.A.

**The authors wish to express their appreciation to Mr. William Floyd, Superintendent, West Lafayette Public Schools, and Mr. James R. Yarling, Principal, Burtsfield School, for their assistance with this project.

into five nearly equal steps from poorest performance to best performance. For each step in the scale a descriptive phrase was provided to guide the examiner in evaluating the performance. For the four measures of motor eye movement these steps were subjective and the phrases designating each step were descriptive of types of movement. In the remaining tests of the series more nearly quantitative designations were provided for these scale steps. The list of tests used and the scale designations are shown in Table 1. No attempt was made to standardize the scaling used here nor to establish the equality of the step intervals. However, from observation of the scale in use, it would appear that the observations can be scaled and that the resulting scores provide useful data.

The measure of school achievement used was the Metropolitan Readiness Test (Form S), kindergarten level. This test is routinely administered at the end of the academic year in the West Lafayette school system. It is largely a measure of readiness to read and is used by the school as a measure of the readiness of the child for first grade material.

Using the school achievement test score as a criterion, an item analysis of each of the tests in the vision series was performed. The Chi-square technique was used to determine which items were significantly related to the criterion. The Chi-square values obtained are shown in the last column of Table 1.

Those tests which showed a Chi-square value equal to the five per cent level of confidence or better were selected for the final battery. This selection resulted in the following nine tests: the four tests of motor movement, the test of stereopsis, the far visual efficiency test, O.D. and O.S., and the near visual efficiency test, O.D. and O.S. The records were then rescored using only these nine items. The scoring consisted of using the scale values shown in Table 1 without modification. Thus the minimum score for each item was one and the maximum score was five. The total possible score for the selected battery then became 45.

RESULTS

Using the scores obtained with the nine item test, a Pearson Product Moment coefficient of correlation was computed between these visual test scores and the achievement test scores. The resulting coefficient was .456 $\pm$ .14. This coefficient is significant well beyond the one per cent level of confidence and is of sufficient magnitude to be useful for prediction purposes.

There is some danger of overestimating a relationship such as the present one when the final correlation is computed on the same group

TABLE 1
Visual Test Scales and Chi-square Values

Test Name	Scale Value 1	2	3	4	5	Chi-square
Binocular Rotations	No Ability to follow	Poor Movements	Fair Movements	Good—very slight defect	Excellent	7.90*
Monocular Rotations	No Ability to follow	Poor Movements	Fair Movements	Good—very slight defect	Excellent	6.64*
Saccadic Fixations	Extremely Poor	Poor Fixations	Fair Fixations	Good—very slight defect	Excellent	16.28*
Near-to-Far Fixations	Extremely Poor	Poor Fixations	Fair Fixations	Good—very slight defect	Excellent	8.10*
Near Point Convergence	8″	6″	4″	3″	To nose	No variability
Donders	1.50 D.	1.00 D.	0.50 D.	Expected	Above Expected	1.48
Amplitude	Below Normal	Below Normal	Below Normal	for Age	for Age	
Simultaneous Perception	Monocular Vision	Sim. Per. But far Apart	Sim. Per. But Overlap	Sim. Per. Slightly Apart	Sim. Per. Directly above	.73
Far Fusion	Two Balls	Four Balls Move	Four Balls Stable	4 3 3 4	Three Balls	3.15
Stereopsis	Misses Four Lines	Misses Three Lines	Misses Two Lines	Misses One Line	All Correct	9.22*
Accommodative Facility (—2.50)	Complete Blur on Both Sides	Complete Blur on One Side	Partial Blur on One Side	Very Short on One Side	No Blur on Either	Negative
Far Lateral Phoria	5.5 or 13.5	6.5 or 12.5	7.5 or 11.5	5.5 or 10.5	9.0 or 10.0	.67
Far Vertical Phoria	□ or ★	+ or ♥	•	♠	♣	Negative
Vis. Eff. O.D.	60%	70%	80%	90%	100%	11.89*
Vis. Eff. O.S.	60%	70%	80%	90%	100%	10.86*
Hand and Eye Coordination	Monocular Vision	Doubling of Numbers	Pointer Tips Missing	Normal Slight Errors	Perfect Coordination	Negative
Near Fusion	Two Balls	Four Balls Move	Four Balls Stable	4 3 3 4	Three Balls	Negative
Near Macular Suppression	Monocular Vision	Alternate Suppression	Macular Suppression	Displaced Cross	Perfect Cross	Negative
Near Lateral Phoria	2.5 or 7.5	3.0 or 7.0	3.5 or 6.5	4.0 or 6.0	4.5 or 5.5	Negative
Vis. Eff. O.D.	60%	70%	80%	90%	100%	8.20*
Vis. Eff. O.S.	60%	70%	80%	90%	100%	12.87*

*P 50

used in the item analysis. For this reason a control group was added to the present study. Sixty-two children in the kindergarten of the Lafayette Public Schools* served as a control group. In testing this latter group a new group of examiners were used. These examiners were given a short training period to acquaint them with the scaling techniques after which they performed the control examinations without supervision.

These tests for the control group were then scored using the nine item battery derived from the data on the experimental group. The resulting scores were correlated with the Metropolitan Achievement Test scores using the Pearson Product Moment coefficient. This coefficient was found to be .449 ± .13. This coefficient from the control group is also statistically significant well beyond the one per cent level and its magnitude compares very closely to that obtained with the experimental group. The data from the control group thus demonstrate that the results obtained with the experimental group are reliable and valid.

CONCLUSIONS

It is felt that the results of this study demonstrate a substantial relationship between visual skills and school achievement at the kindergarten level. The magnitude of the relationship would appear to be of considerable practical importance, particularly in view of the difficulties encountered by most workers in discovering relationships with school achievement at this age level.

Of particular significance is the marked contribution to this relationship made by the four measures of motor eye movements. Since at this age these psycho-motor skills are rather easily trainable, these data would suggest that such training might be helpful in increasing achievement among these young children. Further research designed to investigate the contribution of such training is contemplated.

*The authors wish to express their appreciation to Mr. J. Russell Hiatt, Superintendent, Lafayette Public Schools, and Mr. Don Dawson, Principal of Vinton School, for their cooperation in this project.

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A SYNOPSIS OF GLAUCOMA FOR OPTOMETRISTS

January, 1960, brings the start of a new Academy project, the publishing of the first of a planned series of Home Study Courses for Optometrists. Volume One of this series deals with glaucoma from the standpoint of the optometrist and covers this subject in such a way as to improve the screening of patients who may have this diseased condition.

The first of this series of Home Study Courses is called *A Synopsis of Glaucoma for Optometrists*. The planning for this book started in 1956 and during the past two years the author, Dr. Arthur Shlaifer, wrote the text to meet strict Academy requirements of authenticity, brevity and completeness. We believe he has succeeded very well indeed.

According to Dr. Meredith W. Morgan this Home Study Course on glaucoma is designed to furnish the optometric practitioner with a working knowledge of all aspects of this most important ocular path-

ology. Although glaucoma is still incurable, research continues on all fronts and the pertinent material of the more recent studies is presented in addition to the classical background material.

Understandably, the optometrist's interest is directed toward diagnosis rather than medical or surgical treatment. The material is presented with that in mind. Nevertheless, many optometrists have patients who are currently under ophthalmological care for glaucoma and who also continue to consult them for optometric refractive services. Therefore, it behooves optometrists to be familiar with the general clinical course that glaucoma may follow and with the commonly accepted medical and surgical procedures in the treatment of the pathology. Indirectly, the diagnostic approach is aided by an appreciation of the possible etiology of glaucoma. Perhaps most important of all, a more thorough knowledge of the disease will result in the optometrist keeping constantly in mind the possibility of glaucoma in his patients. An inevitable improvement in case finding will result.

The first chapter deals with introductory material such as definitions, history, classification, factors of age, race, sex, refractive findings and heredity.

Subsequently, the discussion leads to diagnostic procedures which include symptoms and clinical picture, ophthalmoscopy, tonometry (both corneal and scleral), visual fields, gonioscopy, and other miscellaneous aspects.

The anatomical and physiological considerations in the etiology of glaucoma are presented. A short discussion of the pathology of glaucoma follows. Finally, current medical and surgical treatment is discussed. Each chapter contains both a list of references and a series of questions based on the material presented.

The book is published under Academy supervision and the copyright is held by the Academy. Dr. Meredith W. Morgan, Berkeley, California, is chairman of the Home Study Course Committee. The 1960 appointments for this Committee, in addition to Dr. Morgan are: Dr. Benton Freeman, Allentown, Pennsylvania; Dr. Robert C. Graham, Pasadena, California; Dr. Henry B. Peters, Oakland, California; Dr. Max Schapero, Los Angeles, California; and Dr. Arthur Shlaifer, Philadelphia, Pennsylvania. Each of these Committee members also serves as an Academy Section Chairman dealing with a specialized optometric activity.

The book is published by the Burgess Publishing Company. For years this publishing house has specialized in the publication of scientific, medical and technical books. Their current list of available

texts numbers more than 200 titles. The new Academy book *A Synopsis of Glaucoma for Optometrists* by Dr. Arthur Shlaifer brings the Burgess people into their first official contact with Optometry. Because of its importance to both optometry and the public, it is anticipated that Volume I of the Academy Home Study Course series by Shlaifer will have a large and appreciative readership.

Optometrists may send their orders for this new book direct to the Burgess Publishing Company, 426 South Sixth Street, Minneapolis 15, Minnesota. The price of the book is $5.00, postpaid. Order your copy today.

CAREL C. KOCH

SPECIAL REPORTS

A.O.A. PRESIDENT'S ANNUAL ADDRESS BEFORE THE ACADEMY—"STATE OF THE PROFESSION"*

P. N. DeVere†
Morgantown, North Carolina

Distinguished guests, ladies and gentlemen of the American Academy of Optometry. It is a real pleasure for me to have this opportunity to be with you tonight on the occasion of your annual banquet. It is my privilege to extend to you the heartiest greetings on behalf of the Board of Trustees of the American Optometric Association, and to commend the American Academy of Optometry for its continuing contributions of immeasurable benefit to optometry.

As I review the roster of the several hundred individuals who make up the departments and committees of the A.O.A., I am impressed to find in that leadership, a more than liberal sprinkling of names of outstanding members of the Academy. Through this avenue you are carrying out the responsibility of leadership and thus discharge one of the major responsibilities of academies of all types.

I have been impressed with the splendid educational program you offer in connection with your annual meeting. Continuing profes-

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†Optometrist, President, American Optometric Association.

sional education is a responsibility of every professional man not only to himself but to the public which he serves. I am also pleased to see the development of your post-graduate educational program. All of these things combined with the programs of other facets of optometry will lift the profession in the esteem of other professional groups and does guarantee to the public quality service. So I congratulate the American Academy of Optometry on a year of outstanding service to the profession and in the parlance of my old Navy skipper, say, "Well done."

During the last few months we, in America, have permitted a number of blemishes to appear on the face we are presenting to the world. The strikes in our steel industries, the TV quiz scandals, and temporizing at national and state political levels, has detracted and tended to mislead the thinking of those in foreign lands who look to us for leadership.

I doubt that many of us in our daily lives ever pause to think too much about these things. We are generally more interested in the pursuit of our personal affairs. And yet the future for us and for our families can only be made by personal and group responsibility for the tenets of good government and good citizenship which our forefathers held so dear.

One of the fundamental and appealing characteristics of our total national life is the concept of voluntary cooperation. This concept is the very life blood of the American Academy of Optometry and the American Optometric Association. The fact that we have about us on all hands evidences of personal and group irresponsibility make it more important than ever that we take this task of voluntary cooperation very seriously. Without volunteerism on the part of the members of the Academy and the A.O.A., these organizations would soon cease to exist.

Voluntary cooperation is a social device through which individuals can freely join forces to solve problems which are too big for individual action. That is the definition of an association or an academy when we reduce it to fundamentals. Those of you in the audience tonight appreciate more than most this idea of voluntary cooperation. This spirit is contrasted with the social system we find in totalitarian lands—those threatening the very existence of our democracy. The very spirit of democracy involves free citizens in a free land coming together on a voluntary basis to solve their own local problems. In a totalitarian government, the state is the supreme power and there is no room for freedom of thought, freedom of action, or freedom to join forces with

other like-minded individuals to carry forth a project of their own choosing.

We, as association members, have a duty to ourselves and to our country to see to it that this freedom to join together to accomplish the things we cannot do alone will remain ours for all time.

I believe that optometry has been in the forefront of professions who are keeping this spirit alive. We have witnessed during our life time an increase to the size and cost of our federal government until today it has become a gargantuan creature. Many professional men and leaders in industry have become increasingly alarmed at government intervention into business affairs. However, at the same time many of these same professional men and businessmen have lead a parade to Washington for handouts. I can say for optometry that to the best of my knowledge, we have never been in that kind of parade. I think I can say that we fully believe in the spirit of self-reliance, and that we appreciate the opportunity for voluntary cooperation to express this self reliance.

Most of you have probably read the newspaper accounts of Dr. Louis Orr, President of the American Medical Association, calling upon his members to take a more active part as citizens in the political affairs at all levels of our democracy. From our encounters with the medical association representatives at all levels, I have always felt that they have done a pretty effective job in politics. Of course, Dr. Orr in his talk was calling for voluntary action on the part of his members to help stem the tide of government intervention into the health care field. Your A.O.A. has urged its members for many years to be active as citizens in all political affairs and from what I have seen, I would rank our profession very high in the prestige it holds in political circles.

Now let's see how this voluntary cooperation has been working in so far as the A.O.A. is concerned. At the start of this year, we set a basic theme which we entitled "Meeting Optometry's Responsibilities." These included the following areas for special emphasis. (1) student recruitment, (2) interprofessional relations, (3) practice management, (4) public relations, (5) international affairs, and (6) research.

In so far as I am personally concerned, the matter of securing more students for our schools and colleges of optometry is our number one objective for the year. Shortly after the first of the year a nationwide program of student recruitment will be launched by our Committee on Vocational Guidance. Already, two separate national conferences have been held on this subject and both have brought forth many suggestions and ideas that are being incorporated into a master blueprint for

action. I call upon members of the Academy to do your utmost to implement this program at every level of our optometric society. All of the studies conducted so far indicate that we need to produce more students than our colleges will presently hold if we are to meet the need on the part of the public for the services in the years just ahead of us. This problem can and will be solved through a voluntary cooperative effort.

We are actively working in the area of interprofessional relations. The A.O.A. has recently appointed an Eye Care Commission whose responsibility will be to gather the facts on past and present interprofessional relations between all of the facets within eye care fields. Based upon these facts when they are gathered and interpreted, we will launch a long-term program on interprofessional relations which we think will determine optometry's rightful place in the society in which we live. In addition, it will serve to pave the way for amicable relations among all groups and organizations dealing with the visual welfare of the public.

The A.O.A. is continuing its efforts to improve the economic level of the practice of optometry through a thoroughly activated Practice Management Committee. Those of you who have seen some of the results of the work of this committee must agree with me that the continuance and extension of the program of this committee will ultimately bring to every practicing optometrist all of the good things in life that should accrue to a professional man who is rendering a worthwhile service to the public.

In public relations we have been making every possible effort to extend the influence of the American Optometric association to many other national groups outside the A.O.A. We have held conferences with top leadership in such organizations as the American Legion, the Veterans of Foreign Wars, the Jewish War Veterans, the Disabled War Veterans, Parents-Teachers Association and we have found a splendid interest and response in these contacts. It has long been my belief that we have been talking to ourselves long enough—we need now to talk to groups outside our profession. Our overall program of public relations will be augmented and extended, as time and budget will permit, to carry optometry's story to every corner of the land.

American Optometry has a responsibility to optometry internationally and for that reason the A.O.A. has created a new committee on international optometry. Already this committee has been active with UNESCO, WHO and other international health care organizations. It has been in correspondence with optometry in many foreign lands.

We hope that through our aid we will be able to promote a better optometry through education, laws and legislation around the world. As in many other areas of activity, many sections of the world are looking toward the United States for leadership and it is certainly true in optometry.

This year the A.O.A. split its Committee on Research and Standards into two separate committees: one on Research, and the other on Standards. The function of our new Committee on Research will be to stimulate research in the fields of concern to optometry, seek funds for the conduct of such research, and report on this research to the profession. I am personally convinced that one of the reasons we have not had the funds available for all needed research in optometry is simply because we have not made a coordinated effort in determining priority on research projects and in approaching those with funds to invest in such projects. The Committee is at work and I am certain that it will produce results before the year is out.

We have just finished the Interim Meeting of our A.O.A. Board of Trustees in New Orleans. I wish that each of you could have been present during that meeting to listen to the reports of activities, of accomplishments, of goals, and of problems to be met as some 27 departments and committees of A.O.A. made their semi-annual reports to the Board. The amount of activity being conducted in A.O.A. reflects the healthy condition I find within our optometric family. We have our problems, but we are attempting to treat these problems as challenges and opportunities for the profession.

Now I would like to discuss with you one of the areas of our association activity that has become extremely important. This is the work of our Committee on Social and Health Care Trends, so ably headed by Dr. Felix A. Koetting, St. Louis, Missouri. This committee has been actively engaged in studying, reporting, and recommending to the A.O.A. courses of action to take as we wend our way through a rather fuzzy area of the many concepts of health care services provided for the public.

Although Dr. Koetting's committee on Social and Health Care Trends publishes a bi-monthly newsletter, a desk book, and issues numerous information bulletins on the subject, many of us are not fully aware of where the A.O.A. stands in regard to many of these socio-welfare matters. Because those of you here tonight are leaders within the profession of optometry, I would like to brief you on this activity. Let me handle this by posing typical questions asked by members of the profession, and then answering them for you.

First, what is the A.O.A.'s philosophy concerning the various group arrangements for planned payment programs of health care?

The A.O.A.'s philosophy is this—*Wherever* vision care is provided to the public, we believe that it is our responsibility to see to it that the very best possible care is available and is provided.

What is the A.O.A.'s position concerning optometrists employed in union health centers?

Before answering this question, let me say that the answers I am giving here are attitudes as expressed by A.O.A.'s Committee on Social and Health Care Trends. These have not been determined as policy by the Board of Trustees or the House of Delegates. Let me say further that if the A.O.A.'s membership desires these to be crystalized into a formal position, they should be brought before the House of Delegates for ratification. It is the opinion of the committee in answer to the above question that "No impediment should be placed in the way of any optometrist who desires to work in an approved health center. Once the optometrist is working on the project, we should give him every help to improve his position so that the quality of vision care supplied to the public can also be improved."

What is the A.O.A.'s attitude about prepaid vision care as provided through organizations such as California Vision Services, Inc.?

The attitude of the committee is that this is only one of several plans for the provision of vision care in group arrangements. Organizations such as CVS are only the tools by which optometry can enter into the business end of organized professional effort. It would be unseemly for an *association of professional men* to band together to operate as a business which is what these organizations are. Prepayment for vision care is only one of the many types of arrangements by which optometry can provide vision care to groups. There are many others. The A.O.A.'s committee recommends that all possibilities for a type of payment be considered before dealing with any group. Because group arrangements call for bargaining, some means must be found for entering into agreements for contractual relationships with buyer groups so that the members of such groups receive the highest type of vision care. Optometry does not have a monopoly in the field of vision and is therefore in a competitive position. The committee recommends that organizational units of the profession organize non-profit corporations to handle the business end of this field. There is a "product" to sell. Experience has shown that only business type organizations such as this can do the job that must be done in selling optometric services to these types of groups.

Question: What about insurance companies or indemnity plans?

Answer: Again, I refer you to A.O.A.'s philosophy. I reiterate that we believe that wherever vision care is provided it should be on the best possible plane attainable. The A.O.A. committee is working on the national level with several insurance associations. For example, the Health Insurance Association of America. Those of you who attended the Congress held in Washington, D. C., may recall hearing Mr. Joe H. Follman discuss the insurance industry's attitude toward the inclusion of vision care benefits under indemnity type arrangements. They would prefer that vision benefits not be included in the insurance type contracts, however, they look toward the inevitable—and are working with us so that when vision care is provided we can be of assistance to them. Your committee has encouraged the incorporation of what it calls "An optometric benefit" in a number of insurance packages. Outstanding examples are the Retail Clerks Program, with the Occidental Life Insurance Company on the Pacific Coast; the Industrial Health Hospital Association working in Oregon and Washington; and the Continental Casualty subsidiary program in the central valley of California, and several other places. Under these insurance type programs some tens of thousands of subscribers receive vision care services. We work with the local administrators of these programs to protect the patient and the program from abuse both by optometrists and patients.

Should the Social and Health Care Trends Committee of the state association be the same as the Board of Directors of a non-profit vision services corporation?

The committee recommends very definitely not. As I mentioned above, the non-profit service corporation is the business end of our professional efforts. Its board of directors is responsible for the operation of the business. They should be responsible to the majority opinion of the profession and should work very closely with the Social

and Health Care Trends Committee of the state. There is a great deal of difference, however, between the board of directors of this business enterprise and the Social and Health Care Trends Committee of the state association. Social and health care trends, as we interpret it, includes a wide variety of subject matter. First of all, the committee has a responsibility for a continuing study and investigation of all social and health care trends affecting the profession. This includes such areas as public health activities, governmental activities, and all other activities of social and health nature which may affect the long term action of the profession. Once a non-profit corporation is organized and is prepared to do business, it is no longer a responsibility of the Social and Health Care Trends Committee, with the exception that the committee should report to it as well as to the state association any trends that might change its mode of operation.

Is it necessary to have a so-called "optometric controlled program?"

It is the attitude of your committee that vision care be provided along the lines of the A.O.A. recommendation. The best method to assure success is to control it as far as possible. It is not believed that an insurance carrier, Blue Cross-Blue Shield organization, or a labor health center would be as concerned with the details as with the quality of performance.

Should non-members and other licensed eye practitioners be permitted to participate in group vision care programs?

In many states we must allow other professional groups to participate in our programs if we are to operate. Setting aside all legal aspects, it is the opinion of the committee that we should promote freedom of choice of practitioners to be consistent with the A.O.A. general philosophy against discrimination.

Should we lower our fees in order to compete with services rendered by commercial optometrists or optical companies?

The committee recognizes this as a problem for many localities. It must be met on a local basis. The committee's objective is a reasonable and adequate renumeration for services rendered.

Question: Isn't it possible for the A.O.A. to set up some means of certifying group health centers and industrial programs?

Answer: Your committee has prepared a Manual on Standards For the Provision of Vision Care in Health Centers, Clinics and Hospitals. At present this Manual is not a yardstick by which we judge these institutions but instead is considered as a guide for those directors responsible for the operation. The committee hopes to obtain the endorsement of associations such as the Group Health Association of America so that the Manual can be distributed through its offices.

Question: Why doesn't the A.O.A. seek inclusion of vision care benefits in Blue Cross-Blue Shield programs?

Answer: There are two places where vision care programs in optometry have been included under these programs. In the eastern provinces of Canada, the optometric profession worked for and obtained legislation which requires optometric claims to be accepted for vision care benefits in the Blue Cross program. Another place where optometry has participated is in the City of Seattle. This was obtained by a request coming from the city government.

These are just a few of the questions that serve to point up the position we find ourselves in today in so far as this very broad area of social and health care trends are concerned.

Time will not permit me to even begin to outline to you the many, many projects that are currently underway within the A.O.A. I know, however, that I can promise this. When the Annual Congress of the A.O.A. convenes at the Biltmore Hotel in Atlanta, Georgia, June 26, the reports distributed there will show that through the united Volunteer effort of the department directors, committee chairmen, the rank and file members of the A.O.A., and with the aid and assistance

of the Academy and other organized groups within optometry, the profession will have taken another long step ahead toward achieving its rightful place in our society.

Now in conclusion I have only one thing to ask of you. That each of us rededicate ourselves as professional practitioners, as members of state associations united to work together to determine to meet and fulfill optometry's responsibilities, so that we as a profession can make our rightful contribution to the health, safety, and welfare of the American people.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

NOTES ON CHICAGO MEETING OF THE ACADEMY

Optometrists from 36 states, five Canadian Provinces and from England attended the 39th annual meeting of the American Academy of Optometry at Chicago, Illinois, December 9-15 at the Drake Hotel. More than 550 optometrists took part in the Post Graduate Courses, the Section Meetings, and the general convention itself. In addition a number of undergraduate students in professional courses in Optometry from the Illinois College of Optometry and from the Division of Optometry, Indiana University attended the convention. In a very large part the reaction of those in attendance was favorable. The papers that were presented during the general convention itself were excellent and the Section Meetings were up to their usual high clinical standards.

One of the outstanding features of the convention was the honoring of Dr. Ralph S. Minor, Berkeley, California, at the annual formal Round Table Dinner. Dr. Minor, who is now retired, played a leading role as a faculty member of the University of California in the founding and development of what ultimately became the School of Optometry on that campus. Dr. Minor served as the first Dean of that School. He was honored by the Academy for this outstanding contribution to the profession. He received an Honorary Life Fellowship. The award was presented by Dr. Meredith W. Morgan a past president of the Academy and a member of the faculty of the University at Berkeley.

The principal speaker at the Round Table Dinner was Dr. P. N. DeVere, president, American Optometric Association. Dr. DeVere

spoke on the state of the profession. His address, which was very well received, appears elsewhere in this issue. Dr. DeVere was presented to the Academy by President Fitch.

Dr. Lawrence Fitch, dean, Pennsylvania State College of Optometry, was reelected president of the Academy during the annual meeting. Other officers elected were: Dr. Ralph E. Wick, Rapid City, South Dakota, vice-president, and Dr. Carel C. Koch, Minneapolis, Minnesota, secretary-treasurer. Dr. Robert W. Tubesing, Richmond, Indiana, will continue to serve as past president on the Executive Council which will consist of the officers and following elected members: Dr. Donald A. Springer, Anniston, Alabama; Dr. J. Donald Kratz, Souderton, Pennsylvania; Dr. Monroe J. Hirsch, Ojai, California, and Dr. Edward J. Fisher, dean, Ontario College of Optometry, Toronto, Canada.

Dr. Rudolph Ehrenberg, Granite Falls, Minnesota, was again appointed administrative assistant to the Executive Council.

The following appointive officers will serve ex-officio as members of the Executive Council: Dr. V. J. Ellerbrock, School of Optometry, The Ohio State University, Columbus, chairman, Academy Post-Graduate Courses; Dr. Henry W. Hofstetter, Division of Optometry, Indiana University, Bloomington, Academy representative AAAS Council; Dr. Meredith W. Morgan, School of Optometry, University of California, Berkeley, chairman, Academy Home Study Courses; Dr. John D. Perry, Winston-Salem, North Carolina, chairman, Academy Editorial Council, and Dr. Harold Simmerman, Wenonah, New Jersey, chairman, Academy Committee on Admittance. Dr. Springer, in addition to his duties as member of the Executive Council, will serve as chairman of the Papers and Program Committee for 1960. He will be assisted by Dr. John Zettel, Jr., Cincinnati, Ohio.

During the sessions of the Executive Council plans were outlined for the 1960 meeting of the Academy at the Palace Hotel, San Francisco, December 7-13. The Council spent considerable time going over plans and suggestions for the Post-Graduate Courses which will be offered to all optometrists at San Francisco. The Council also directed its attention to planning for wide distribution of the first of the American Academy of Optometry series of Home Study Courses. Volume I of these Course is now available. It is entitled *Synopsis of Glaucoma for Optometrists* by Arthur Shlaifer, O.D., Ph.D. of the faculty of the Pennsylvania State College of Optometry. This book, which should be in the hands of every optometrist, has been published for the Academy by the Burgess Publishing Company, 426 South Sixth Street, Minneapolis 15, Minnesota. The cost is $5.00. Orders and checks should

be sent direct to the publisher.

The proposed nationwide campaign dealing with better vision and sponsored by the Optical Manufacturers Association was considered by the Executive Council who approved the following policy statement relating to this event.

> "The announcement by the Optical Manufacturers Association of their proposed public information program is of great interest to the Academy. We understand that this program will stress the importance of and need for quality ophthalmic materials and good professional eye care. We believe that specific product advertising should be directed to the profession, while general information is best directed to the public. Such an informational program will be in the best interest of the public's vision and health and will also have a beneficial effect upon the optometric profession. We, therefore, commend the O.M.A. for considering such a program of public information and urge them to proceed with it."

During the annual Round Table Dinner Dr. Harold Simmerman, Wenonah, New Jersey, chairman of the Committee on Admittance, introduced a group of Academy applicants who had successfully completed their work and who had just become newly-elected Fellows of the Academy. These new members are:

Dr. William R. Baldwin, Indiana University, Division of Optometry, Bloomington, Indiana. Dr. Charles A. Bayshore, 33 E. Robinson Ave., Orlando, Florida. Dr. Jerrold Beckerman, 415 McCallum-Hill Bldg., Regina, Saskatchewan, Canada. Dr. Bernard J. Berstein, 1985 Smith St., Centredale, Rhode Island. Dr. Charles S. Bloom, 24 Green Ave., Madison, New Jersey. Dr. Lamar A. Brown, Meadows Street, Vidalia, Georgia. Dr. Leon Candeub, 1401 Bruce Rd., Oreland, Pennsylvania. Dr. Samuel Clay Chapman, 8 North Main Street, Liberty, Missouri. Dr. Edward Feiner, 201 Main St., Toms River, New Jersey. Dr. Leon M. Ginsburg, 550 Moody St., Waltham 54, Massachusetts. Dr. Bernard Grolman, Research Center, American Optical Co., Southbridge, Massachusetts. Dr. LeRoy Harris, Park Building, Griffin, Georgia. Dr. Oscar B. Hill, 1009 Farmington Avenue, West Hartford 7, Connecticut.

Dr. Martin Huberman, 935 Market St., Marcus Hook, Pennsylvania. Dr. Allan A. Isen, 337 Cleveland Drive, Buffalo 15, New York. Dr. Curtis F. Kenitz, Jr., 804 N. 27th St., Milwaukee 8, Wisconsin. Dr. A. Neil Kerns, 23 Medical Arts Building, Butler, Pennsylvania. Dr. Shahane T. Kirman, 29 West Main St., Hummelstown, Pennsylvania. Dr. Hollis K. Leathers, 223 N. Third St., Muskogee, Oklahoma. Dr. V. Eugene McCrary, 6901 Baltimore Blvd., College Park, Maryland. Dr. Sylvester W. Neary, 401 Third St., Aurora, Indiana. Dr. Houston B. Odom, 414 Textile Building, Greenwood, South Carolina. Dr. G. David Orr, 336 E. Lincoln Highway, Coatesville, Pennsylvania. Dr. Charles H. Parham, Coleman Arcade, 3-R, Melbourne, Florida. Dr. Richard V. Piel, 2043 Englewood Ave., Baltimore 7, Maryland.

Dr. Everett N. Pierce, 21 Park Street, Attleboro, Massachusetts. Dr. Howard F. Rees, 305 Florida National Bank Bldg., St. Petersburg 1, Florida. Dr. Leon A. Reich, 1916 Avenue K, Brooklyn 30, New York. Dr. Carroll W. Rush, 302 County Bank Bldg., Greenwood, South Carolina. Dr. Henry V. Sawyer, Dixon Building, Marion, South Carolina. Dr. Abraham Shapiro, 530 Silas Deane Highway, Wethers-

field, Connecticut. Dr. Morton W. Silverman, 1399 Warwick Ave., Warwick 5, Rhode Island. Dr. Herbert S. Silverstein, 454 Warren St., Hudson, New York. Dr. Alvin L. Sirkis, 109 N. Union Ave., Havre De Grace, Maryland. Dr. David P. Sloan, Jr., 918 W. Main, Leesburg, Florida. Dr. Roy L. Soloff, 18 S. Stenton Place, Atlantic City, New Jersey. Dr. E. William Spitz, 613 Penn Street, Reading, Pennsylvania.

Dr. Wilbur B. Stover, 914 West Olive, Porterville, California. Dr. M. David Thau, 161 W. 72nd St., New York 23, New York. Dr. William E. Tucker, 904 Pendleton St., Greenville, South Carolina. Dr. Harvey M. Tuckman, 34 West Ave., South Norwalk, Connecticut. Dr. Roy F. Underwood, 60 E. King St., Shippensburg, Pennsylvania. Dr. Edward T. Uyesugi, S. E. Court, Paoli, Indiana. Dr. Robert C. Van Hoven, 3425 S. Division Ave., Grand Rapids 8, Michigan. Dr. Robert B. Weiss, 1233 Albany Ave., Hartford 12, Connecticut. Dr. Earl E. Wilson, 124½ North Bridge St., Chippewa Falls, Wisconsin. Dr. William H. Wood, 218 W. Adams St., Jacksonville 2, Florida. Dr. Norman I. Zipper, 2116 West Pratt Street, Baltimore 23, Maryland.

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ANNOUNCEMENT

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From its foundation it proved highly successful. Enquiries have been received from 26 countries. The first three courses in 1957, 1958 and 1959 were attended by optometrists from the following countries: Cyprus, Denmark, France, Germany, Holland, Ireland, New Zealand, Norway, Spain, Sweden, Switzerland and Yugoslavia.

The course will commence on Friday, May 6th, 1960, at 10 a. m. at Rotary House, 21 Portman Square, London, W.1, and end on Friday, June 3rd. The total inclusive charge for tuition for the month is £38 15s. 0d. or its equivalent in other convertible currency. £5 of this is payable with the application to join and the balance is payable at the start of the course. The application fee of £5 or its equivalent in other currency, should be returned to C. S. Flick, 19 Chilworth Mews, Craven Road, London, W.2, England, as soon as possible.

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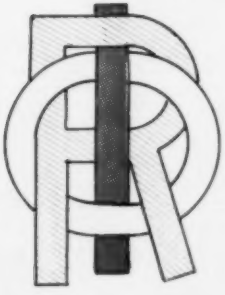

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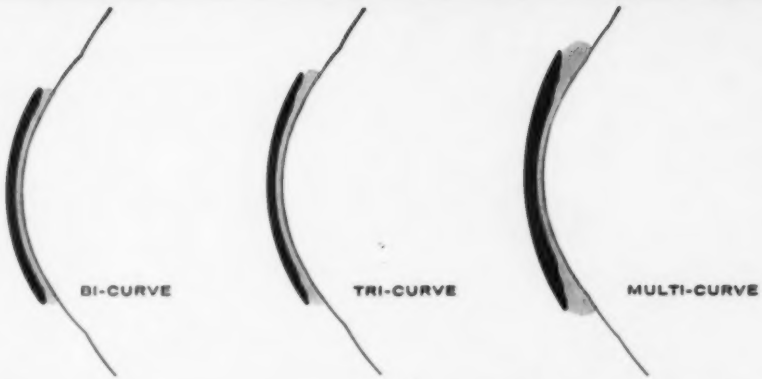

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